THE

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CONTENTS:

	PAGE
The Penalty Clause	741
Electric Power in a Shipyard (*illustrated*)	743
The Current Produced in an Inductive Coil by a Parabolic Wave of E.M.F. (*illustrated*)	744
Steam Turbines	745
The Glasgow Tramway Contracts	746
The Pidgeon Influence Machine (*illustrated*)	747
A Repeater for Use in Wireless Telegraphy (*illustrated*)	749
Electric Lighting in Shoreditch	750
Correspondence:—Penalty Clauses	751
The Pimbley Economiser	752
Arc Lamps and How to Maintain Them	752
Babcock & Wilcox Superheater	752
Re Answers to Situations Vacant Advertisements	752
Telegraphing to Trains in Motion (*illustrated*)	753
Signalling without Contact	753
Legal	754
Business Notices, &c.	756
Messrs. C. A. Parsons & Co.'s Heaton Works (*illustrated*)	761
Niagara Power Works (*illustrated*)	765
City Notes	770
Traffic Receipts	772
Stocks and Shares	772
Share List of Electrical Companies	773
Market Quotations	774
Standardising in Engineering Construction	775
The Morrin Climax Water-tube Boiler (*illustrated*)	775
Electric Railways in America	776
Generation and Electrical Distribution of Motive Power	778
A New Incandescent Lamp Factory	779
Refuse Destruction	779
Transmitting Pictures by Electricity (*illustrated*)	780
The Penalty Clause	780
Electrical Distribution of Motive Power	782
Reviews	783
New Patents	784
Abstracts of Published Specifications	784

THE

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THE PENALTY CLAUSE.

WE publish in another column of the present issue an article upon this subject, which has been written as an addition to that which may be found in the ELECTRICAL REVIEW for October 27th. Our previous treatment of the subject embraced a short sketch of the law which is applicable to the interpretation of this important clause, which finds its way into nearly every contract for the erection of electric installations. Since then certain matters have come to light which go to show that the question is one of greater moment than might be at first supposed. Among the many disastrous consequences of industrial warfare, none is more burdensome than the effect which it has upon contracts subsisting at the outbreak of hostilities. In spite of the clause—now almost common form—which prevents the actual period of time during which the strike lasts from penalising the unfortunate contractor, he dreads, and has good reason to dread, the existence of a dispute in any department of trade. So closely associated are the various industries which must combine to produce the necessary plant for the lighting of a town, that a stoppage in one department of manufacture is certain, either sooner or later, to affect the due completion of contracts, which cannot be satisfactorily performed unless all the wheels of commerce have been running smoothly. And so we may safely assume that undertakings, which at this present moment are a heavy burden to electrical engineers, have been rendered difficult of performance by the great dispute which staggered the engineering trade in 1898, assisted, possibly, by the great coal strike which preceded it. Although it affords temporary relief, the strike clause fails to relieve against the far-reaching consequences which penetrate every branch of industrial life, not only at the time, but long after the dispute has been brought to a happy termination.

In illustration of the above statement, we hear from many parts of the country bitter complaints against the penalty clause, which, if stretched to the end of its legal tether, constitutes a very powerful weapon in the hands of the municipal corporations. Thus we are told of a contract for the supply of machinery for £2,000, in respect of a breach of which a claim for £1,500 was made—and this, too, where the corporation was shown to have suffered no loss by reason of the delay. This case is, in all conscience, bad enough, but it pales before one which comes from another part of the kingdom. There the contract was for £3,200, and no less than £4,000 was claimed as, and for, liquidated damages for non-completion by a certain day! In another instance we learn that a wealthy corporation has exacted a penalty of £700 where the delay was caused—aye, and palpably caused—by congestion which has taken place owing to the dispute in the engineering trade!

Before entirely condemning the local authorities who thus force the hands of their contractors, it is only fair to say a word as to what should be the object of a penalty clause.

D

If used as a means of securing the erection of valuable plant at an absurd price, it is nothing more than an abuse. But if, on the other hand, the local authority insert the clause for their own protection, and only enforce it in cases where there has been unconscionable delay and neglect on the part of the contractor, no voice can be heard to cry out against it. But we are led to believe that it *is* used as a means of oppression in various parts of the country. The labour element, which is often represented on the corporation of a town or borough, occasionally seeks to pay off old scores against the employer of labour whose contract and whose unavoidable delay come before the Council for discussion. Where the more lenient members of the board might be inclined to use moderation, a discordant note is struck by persons who avail themselves of their position on a public board to fight the battle of the trade unions.

We even hear of the penalty being demanded in cases (*a*) where the Corporation cannot possibly complete their installation, much less commence to make use of it, owing to the non-delivery of other essential parts of the machinery; and (*b*) where the existing plant with a very little extra work is quite capable of meeting all immediate wants. No doubt many Corporations adopt this course with the idea that they are advancing the interests and reducing the liabilities of the "unfortunate ratepayer." But is it not at least arguable that their very parsimony defeats itself in the long run, inasmuch as it does not tempt a contractor to use his very best materials and apply his most skilful workmanship to an undertaking which, if not completed within an almost prohibitive time, may involve a heavy loss?

A perusal of the article which we publish elsewhere in this issue will show that the Court cannot often stretch out its hand to assist the contractor who has undertaken to supply machinery within a certain time. His only way out of the difficulty must be either to combine with other contractors and refuse to sign any document which contains a penalty clause, or else refuse to take any order unless, by the exercise of superhuman foresight, he is able to decide whether it can be fulfilled or not. Whatever the method adopted, it is clear that some steps should be taken by contractors to obtain fair treatment at the hands of the local authorities who employ them. "The lowest tender" usually gains the day, but the essential feature of a tender is that the contractor has estimated his profit and expenditure beforehand. Strike out or modify the penalty clause, so that the risk shall be confined to reasonable limits, and profits, even if they are lower, will, at any rate, be more certain than they are at present.

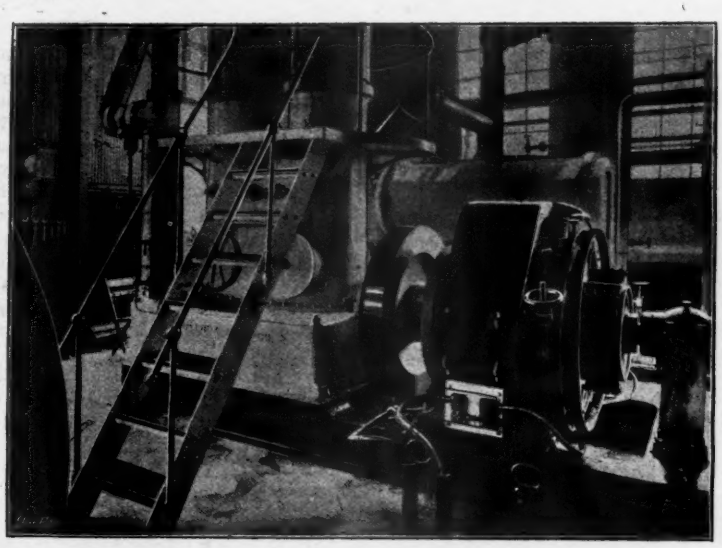
Mechanical Stokers on Board Ship.—The *Journal* of the American Society of Naval Engineers contains an account of the test of the lake steamer *Pennsylvania*, not only in respect of its various engines, but also of its machine stokers. This test was made under the auspices of the Bureau of Steam Engineering of the United States Navy. The steamer in question is 450 feet long and has a displacement of 10,155 tons. She has quadruple engines of 1,600 H.P. and two water-tube boilers of the Babcock & Wilcox type for 250 lbs. pressure. There are three underfeed mechanical stokers, made by the American Stoker Company, and an inferior quality of fuel is employed, having a calorific value as shown by a Mahler bomb of only 11,790 B.T.U. per pound. We have before described this stoker, but may repeat that it has a central magazine, a hopper, a screw conveyor, a wind box, cast-iron air block, and an independent steam engine driving the conveyor shaft. The coal is forced slowly into the central magazine, from which it gradually overflows the air blocks. The volatile matter is driven off and burned, and the coked residue is burned on the grates at each side. The evaporation of 8·8 lbs. of water is said to have been secured, or 10·9 lbs. per pound of combustible, a result of great excellence and fully demonstrating the value of machine stoking. The day should be welcome when stoking by mechanical means becomes universal. None but those who have had actual experience of stoking in a tropical climate can be aware of the horrors of the occupation. There is no reason to doubt that before many more years the problem of machine stoking at sea will have been satisfactorily solved. Mechanical stoking has of late years made rapid progress in America. This is because all their boilers are practically underfired and there is room for the machines. The Jukes grate, once so common in Yorkshire, has been largely applied under another name in America. Its use in England has become small since underfiring has fallen into disuse, but we are surprised not to see it more used under water-tube boilers, for which it is well fitted. Internally fired boilers are more difficult to stoke by machinery, principally because there is not room in their furnaces except for nearly horizontal grates, but the larger furnaces of marine boilers afford more room for such grates as the Jukes and others than the 33-inch furnaces, until recently standard on land, where now 38 and 41, and even 44 inches are becoming usual in present-day larger boilers. Stoking ought to be just as much a duty to be performed by machinery as is feed water pumping. We did once meet with a steam boiler—it was in a printing office in Blackpool—where there was no feed pump or injector, and feed was put in by a pail at the safety valve, steam being let down every time for the purpose. We marvelled. In a few years men will make a special note, it is hoped, if they see the fuel fed by hand. Well attended stoking machines can be made economical, but they must have fair attention, like all other machinery.

Skin Effect in Aluminium Wires.—Owing to the fact that the increase of resistance of conductors of alternating currents, due to what is called the skin effect, increases with the diameter, fears have been entertained, says the *American Electrician*, by some engineers, that this effect would seriously reduce the efficiency of long-distance transmission lines using the great cross sections of aluminium necessary for carrying considerable amounts of current, especially on such lines as use a frequency as high as 60 cycles. The effect is, however, exactly the same as in copper lines of equivalent cross section. This is due to the fact that the skin effect expressed as a ratio of the ohmic resistance under alternating currents to that of the same conductor with direct currents, depends both upon the specific resistance of the material and upon the diameter of the wire or cable. An increase in diameter causes an increase in the skin effect, which is, in reality, an unequal distribution of the current, by which there is a greater density of current at the surface of the wire. If, however, the specific resistance of the conductor is greater, this greater resistance tends to prevent the unequal distribution of the current. The two elements vary in such a way, that if the diameter of the material having a greater specific resistance be made sufficiently large to give the same resistance in a given length to the flow of a direct current, then the tendency to skin effect, due to increased diameter, is just counter-balanced by the increased specific resistance. The skin effect, therefore, in a copper wire is just the same as it is in an aluminium wire, if the diameter of the aluminium wire is increased so that it has the same ohmic resistance as the copper wire. This relation can be seen immediately from the formula for skin effect, as the terms representing specific resistance and diameter of wire are so related that when material of a different specific resistance is used, the consequent change in diameter, in order to maintain the same resistance in the conductor, causes no change in the value of the fraction representing skin effect.

ELECTRIC POWER IN A SHIPYARD.

The part which electricity plays in the building of the modern ship, as shown at the works of the Chicago Shipbuilding Company, embraces nearly every one of its ordinary applications, from lighting to telephone service, with the exception of heating. In the application of motors to the details of shipbuilding it is believed that the Chicago yard is in advance of all other shipbuilding plants in existence. This is doubtless due, says the *American Electrician*, to which we are indebted for the following notes and the illustration which accompanies them, to the fact that the Chicago works are of recent establishment and purely modern design.

In order to understand the various uses of electricity at this point, some idea should first be obtained of the character and extent of the yards and the work done there. The works of the Chicago Shipbuilding Company are located at 101st Street and the Calumet River, in Chicago, in the part of the city known as South Chicago. In building its plant, the company has had one great advantage over most older establishments. The whole yard was laid out in the beginning for a complete plant. All additions made since the start have, therefore, been according to the original general plan. The yard is on this account more systematically and conveniently arranged than most yards that, starting on a small scale, have had their facilities extended by a process of gradual addition.



Power Station of Chicago Shipbuilding Company.

The Calumet River, at 101st Street, being only 225 feet wide, the Chicago Shipbuilding Company's yard had to be laid out to build ships on a level keel and launch them sidewise. Three slips at right angles to the river were dredged out and docked, giving six building berths. These building berths are kept in use almost continually. At present there are four ships in process of construction in the yard and one has been delivered within the last few days.

Two steam locomotive trains run about on the tracks and do invaluable work in loading and unloading material. Besides the full gauge tracks a complete system of Hunt narrow gauge railroad runs from the plate and channel shops to the building berths.

In this plant some of the largest and handsomest vessels on the Great Lakes have been constructed. They are all built of steel, according to the most approved methods of modern shipbuilding, with certain peculiarities and specialties of the Chicago Shipbuilding Company in addition. As a rule the largest size freighters are built, but some handsome passenger steamers have also been turned out by the company. Notable among them are the steamships *Maniton* and *Illinois*, the pick of all the vessels running regularly on Lake Michigan.

The part which electricity takes in building these great lake vessels begins at the power house. This building is situated almost exactly in the centre of the big 25-acre tract, and supplies every part of it with light and power. It is made of iron, thoroughly fireproof, and contains the boilers, engines and dynamos, as well as considerable air-compressing machinery.

The boilers are six in number. Two are Berry boilers of 300 H.P. each. The other four are of the Scotch marine type, of 500 H.P. each. They are located in the west wing of the power house, with the usual feed pumps, &c. The stack is of steel, and is small, forced draught being used. The engine room takes up the greater part of the power house. It contains two large air compressors for the pneumatic service of the yard, the steam and electric units and the switchboard.

The main generating set consists of a 150-KW. Elwell-Parker dynamo, connected directly to a 200-H.P. compound Willans engine. For night service a 40-H.P. Edison dynamo, belt connected to a Rice engine, is used. A spare General Electric dynamo of 50 KW. capacity, driven by a compound Lake Erie engine, is held in reserve for accidents.

The switchboard is necessarily simple and ordinary. Nine lighting and power circuits run out from the board to all parts of the yard, the largest wires used being 350,000 cm. in gross sections. The entire system, light and power, is run at 220 volts, direct current. There are 35 arc lights in use and 400 incandescent.

The power circuit has on it 18 motors in various parts of the yard, aggregating over 300 H.P. The nearest is a few feet away from the switchboard and the farthest is in the dry dock shop, over 2,000 feet away. These motors range in size from 5 H.P. to 50 KW., and vary in type almost as widely. The variety of uses to which they are put is interesting.

The nearest motor to the switchboard is a 15-H.P. C. & C. It is used to give the forced draught in the boiler room. In the blacksmith shop the most recent application of motors has been made. This is a new structure of iron and glass 60 × 100 feet in floor area and 40 feet high. It is equipped with the down shaft system of the Buffalo Forge Company, which gives a blow and suction both at each forge. A 25 H.P. Crocker-Wheeler motor is belted directly without the intervention of line shafting to both blowers. Sixteen forges are thus supplied with air pressure, and have their gases removed.

The machine shop is the scene of the greatest use of electric motors in the Chicago Ship Building Company's yard and its owners consider it to be the finest specimen of a marine engine shop in the United States. It is constructed entirely of steel and glass, a large quantity of the latter material being used. It is probably the lightest shop of its kind in the country, and has been found cool in summer and easy to heat in winter. The main portion of the shop is 60 feet wide and 60 feet high to the roof trusses. There are no galleries, the work being done on the main floor, which is under the direct supervision of the foreman in charge. On either side of the central portion of the shop is a 30 feet wing. In area, therefore, the shop is really 200 feet long by 120 feet wide. There are only eight columns in this space to obstruct the view or hinder operations.

The uses of electric motors in this shop are of two kinds—to drive line shafting and to run separate tools. Besides these there is a travelling crane which is motor driven. The line shafting is located in the wings of the shop, and drives the smaller lathes and tools. An Elwell-Parker 20-H.P. motor placed on a platform in each wing is belted to the shafting. The direct driven tools are in the main portion of the shop on the floor. The entire centre portion is spanned by the electric crane, which is of the 25-ton size, made by the Brown Hoisting Company. This is driven by three Elwell-Parker motors. The columns of the shop were made heavy enough to stand two 25-ton electric cranes, and

undoubtedly the second will be installed before long. Brackets were also put on the main columns about 25 feet from the floor, on which to support a smaller crane girder. This is intended to carry a 10-ton crane under the main cranes, which will be called on to do most of the light lifting in the shop.

The machine shop tools driven by motors are of particular interest, owing to their large size and remarkably successful operation. They include lathes, drills, planers and milling machines. A 72-inch screw cutting lathe made by the Niles Tool Works is fitted with a 5-H P. Elwell-Parker motor. The feature of the machine-driven tools, however, is the Niles Tool Works horizontal boring mill. This is one of the largest tools of its kind in the country. It has proved remarkably handy on account of the variety of work it will do and the number of operations which can be performed at one setting of the work. This tool is driven by a 5-H.P. Crocker-Wheeler motor, which will give a wide speed variation to the drills. A vertical boring mill, made by the Pond Machine Tool Company, is run by a 10-H P. General Electric motor at a constant speed.

In the plate and channel shops the various machines are all driven from line shafting turned by electric motors. Two of the latter are used, one at either end of the building. They are put at the level of the line shafts on platforms, and are belted to the shaft pulleys. They drive, through the shafting, the punches, shears, rolls, reamers, planers and counter sinks used to handle the plates for the ships' sides, and the angle shears, punches and bending machines used on the angle irons. In the channel shop there is a powerful bending machine, built by William Sellers & Co., which will bend cold a 24-inch I beam between supports 4 feet apart. All deck beams for the ships are cambered cold on this machine.

The joiner shop has the largest electric motor used in the yard. It is a 50 H.P. General Electric machine, and is used to drive the entire line shafting for the building. It is placed on a platform at one end of the building, and is belted to the shaft.

The dry dock is the largest on the Great Lakes. The The extreme length is 540 feet and width 100 feet. Sixteen feet of water is given over the mitre sill at ordinary river depth. The dock is emptied by steam centrifugal pumps with a capacity of 50,000 gallons a minute. A small oil burning plant is provided for the purpose. Beside the dock, and really forming part of it, is the repair shed, or house, where the repair work on vessels is done. A 30-H.P. Elwell-Parker motor drives the line shafting in the building, turning the various lathes, saws and tools. It is connected in the same manner as the other motors driving line shafting. This motor is 2,000 feet away from the power house.

Up to the present, the principal work in the building berths has been done by a pair of steam travelling cranes and the locomotive cranes. Now, however, 25-ton electric cranes are being installed over the berths, two for each of the four middle berths. They are made by the Brown Hoisting Company, and fitted with Elwell-Parker motors. They are a great improvement in speed and convenience over the steam cranes.

On the dock at the river front stands a huge steel sheer with legs 100 feet high. This is used for stepping masts and lifting heavy material, including the engines, into the ships after launching. It has a capacity of 100 tons. There are three legs, the back one being operated by a horizontal screw to throw the head of the sheer in and out. This screw is driven by a steam engine, but is soon to be operated by an electric motor. The sheer was made in the yard.

In the finishing of the vessels the electric work is most important. Small marine electric lighting plants are now in every ship of size, even if it is to be used only for freight. This work, as well as the general electrical supervision of the dockyard is under the charge of C. C. Mattison, the electrician of the company. As many as 40 men are frequently employed in the wiring gang. A representative of the work done is in the *Maunaloa*, a large steam freighter, is 460 feet long, delivered to the Minnesota Steamship Company a few days ago. The electric plant consisted of two 10-KW. General Electric marine type dynamos driven by high speed engines. The switchboard, made by the Chicago Ship Building Company, is of slate, with Weston instruments and switches made in the works. Ten branch circuits run from the board. The wiring is all in moulding. The lamp sockets are made watertight both in the engine room and hold and above deck. The work is carried on in a construction and repair shop occupying a portion of the storehouse.

The telephone system of the works is one of the handiest things on the grounds. It was installed by the American Electric Telephone Company. A 25-drop switchboard is in use, located in the office building. It has 20 telephones in the various buildings of the yard connected to it.

THE CURRENT PRODUCED IN AN INDUCTIVE COIL BY A PARABOLIC WAVE OF E.M.F.

By ALEXANDER RUSSELL, M A.

The problem of finding the impedance of an inductive coil acted on by a wave of E.M.F. which does not follow the harmonic law presents some difficulty, yet it is necessary to work out the solution for various curves if we wish to understand how the shape of the wave affects the current produced by it. In what follows we have given the solution for the case of a parabola, as owing to its likeness to a sine curve the results can be readily compared with the ordinary theory, and hence may correct some misconceptions caused by an exclusive study of the sine curve. As the proofs involve a considerable amount of algebra they have been omitted. For the methods of solving the differential equations, &c., the reader may be referred to Perry's "Calculus for Engineers."

We will consider an inductive coil, whose resistance is R and whose self-inductance is L. We will suppose that there is applied to it (1) a sine curve wave of E.M.F. and (2) a parabolic wave of E.M.F., each of which maintains the same effective voltage V between its terminals.

Equations to E.M.F. Curves:

(1) $v = \sqrt{2}\,\mathrm{V} \sin 2\pi f t.$

(2) $v = 4\sqrt{30}\,\mathrm{V} f^2 \left(\frac{t}{2f} - t^2\right)$ from $t = 0$ to $t = \frac{1}{2f}$.

In these equations

v = the instantaneous value of the volts,

f = the frequency,

t = the time in seconds.

These curves are shown in the figure on the next page.

Equations to Current Curves:

$$(1)\quad i = \frac{\sqrt{2}\,\mathrm{V} \sin(pt - a)}{\sqrt{\mathrm{R}^2 + p^2\,\mathrm{L}^2}},$$

where $\tan a = \frac{p\,\mathrm{L}}{\mathrm{R}}$, $p = 2\pi f$ and i is the instantaneous value of the current.

$$(2)\quad i = \frac{\mathrm{K}}{\mathrm{R}}(at - t^2) - \frac{\mathrm{K\,L}}{\mathrm{R}^2}(a - 2t) - \frac{2\,\mathrm{K\,L}^2}{\mathrm{R}^3} + \mathrm{B}\,e^{-\frac{\mathrm{R}}{\mathrm{L}}t}$$

where $$\mathrm{K} = \frac{\mathrm{V}\sqrt{30}}{a^2};\quad a = \frac{1}{2f},$$

and $$\mathrm{B} = \frac{4\,\mathrm{K\,L}^2}{\mathrm{R}^3\left(1 + e^{-\frac{\mathrm{R}}{\mathrm{L}}a}\right)}$$

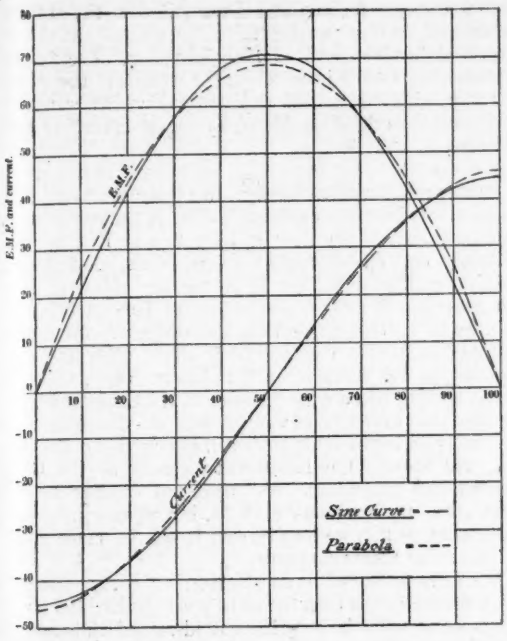
Equations to Choking Coil Currents:

In this case R equals zero.

$$(1)\quad i = -\frac{\sqrt{2}\,\mathrm{V}\cos pt}{p\,\mathrm{L}}.$$

$$(2)\quad i = -\frac{\mathrm{V}\,a\sqrt{30}}{\mathrm{L}}\left\{\frac{1}{12} + \frac{1}{3}\left(\frac{t}{a}\right)^3 - \frac{1}{2}\left(\frac{t}{a}\right)^2\right\}$$

These are the equations to the curves drawn in the figure, and it is interesting to note how nearly coincident they are.



The Impedances:

(1) $\sqrt{R^2 + p^2 L^2}$

(2) $R \left\{ 1 - 40 \left(\frac{Lf}{R}\right)^2 + 1{,}920 \left(\frac{Lf}{R}\right)^4 - 7{,}680 \left(\frac{Lf}{R}\right)^5 \frac{e^{\frac{R}{2Lf}} - 1}{e^{\frac{R}{2Lf}} + 1} \right\}^{-\frac{1}{2}}$

In (2) e is the base of Naperian logarithms, and equals 2·71828. At first sight these expressions look very unlike each other, but they really are always very nearly equal to one another. For example, suppose that $2Lf$ is greater than R, then we may write them as follows :—

(1) $Lf \left\{ 0{\cdot}02533 - 0{\cdot}0006416 \left(\frac{R}{Lf}\right)^2 + \dots \right\}^{-\frac{1}{2}}$

(2) $Lf \left\{ \frac{17}{672} - \frac{31}{48{,}384} \left(\frac{R}{Lf}\right)^2 + \dots \right\}^{-\frac{1}{2}}$

$= Lf \left\{ 0{\cdot}02530 - 0{\cdot}0006407 \left(\frac{R}{Lf}\right)^2 + \dots \right\}^{-\frac{1}{2}}$

Effective Values of Choking Coil Currents:

(1) $0{\cdot}15915 \frac{V}{f L}$.

(2) $0{\cdot}15905 \frac{V}{f L}$.

Effective Values of Condenser Currents:

If the waves be applied to a condenser whose capacity is K farads, the effective currents in amperes are—

(1) $6{\cdot}283\ K\ V\ f$.

(2) $6{\cdot}324\ K\ V\ f$.

The Power Factors:

(1) $\frac{R}{\sqrt{R^2 + p^2 L^2}}$

(2) $\left\{ 1 - 40 \left(\frac{Lf}{R}\right)^2 + 1{,}920 \left(\frac{Lf}{R}\right)^4 - 7{,}680 \left(\frac{Lf}{R}\right)^5 \frac{e^{\frac{R}{2Lf}} - 1}{e^{\frac{R}{2Lf}} + 1} \right\}^{\frac{1}{2}}$

The Reactances:

If we have an inductive coil and there is no hysteresis or eddy current loss, then, whatever the shape of the wave, the reactance is $\sqrt{I^2 - R^2}$, where I is the impedance. Substituting in this formula the values of the impedances given above we find the reactances.

Proof that the impedance with the sine wave is always less than the impedance with the parabolic wave.

We can show by Fourier's theorem that if I be the impedance with the parabolic wave, then

$$\frac{1}{I^2} = \frac{960}{\pi^6} \left\{ \frac{1}{R^2 + p^2 L^2} + \frac{1}{3^6} \frac{1}{R^2 + (3\,p\,L)^2} + \frac{1}{5^6} \frac{1}{R^2 + (5\,p\,L)^2} + \dots \right\}.$$

Hence $\frac{1}{I^2}$ is less than

$$\frac{960}{\pi^6 (R^2 + p^2 L^2)} \left\{ 1 + \frac{1}{3^6} + \frac{1}{5^6} + \dots \right\},$$

but the sum of $1 + \frac{1}{3^6} + \frac{1}{5^6} + \dots$ is $\frac{\pi^6}{960}$, therefore, $\frac{1}{I^2}$ is less than $\frac{1}{R^2 + p^2 L^2}$, and hence I^2 is greater than $R^2 + p^2 L^2$. This proves the theorem.

It can also be shown that the ratio of the current produced by the sine wave to the current produced by the parabolic wave increases as $\frac{L}{R}$ increases. When L is zero the ratio is unity, when R is zero the ratio has its maximum value 1·0005.

In conclusion, we will state some of the results shown by the above formulæ :—

1. If we have a sine wave and a parabolic wave of E.M.F. giving the same effective volts, then the parabolic wave is more flattened than the sine wave. The maximum ordinate of the sine wave is about 3 per cent. higher than the maximum ordinate of the parabola.

2. The ratio of the area of the parabola to the area of the sine curve is 1·014. This also gives the ratio of the maximum values of the choking coil currents.

3. If both waves be applied separately to a non-inductive resistance, the effective values of the currents produced will be equal. If they be applied to an inductive coil then the current produced by the sine wave will be the greater. If they be applied to a condenser the current produced by the parabolic wave will be the greater.

4. For an inductive coil the power factor is always greater for the sine curve, and the impedance and the reactance are both greater for the parabola.

5. The impedance for the parabolic wave is not of the form $\sqrt{R^2 + q^2 L^2}$, where q is some function of the frequency. In this case also the angle whose cosine equals the power factor is not in general the angle of time lag of the current curve behind the E.M.F. curve.

STEAM TURBINES.

In his presidential address to the Institution of Junior Engineers, the Hon. C. A. Parsons discusses his steam turbine. He states that steam engines which generate 1 effective H.P.-hour with $1\frac{3}{4}$ lbs. of coal, weigh, including boiler, 20 lbs. per H P., or even as low as 8 lbs. in the case of flying machines. Oil engines weigh $39\frac{1}{2}$ lbs., and use ·82 lb. of oil; hot air engines use 2 to 8 lbs. of coal; while gunpowder engines or cannon use 4·1 lbs. of cordite per H P.-hour in the shot, this weight of cordite being equal to ·7 lb. of coal. The weight of a 6-inch quick firing gun, without mounting, is 10 lbs. per average effective H.P. in the shot at six rounds per minute. In a Maxim gun the weight is only 1 lb. per H P.-hour on the same basis.

Both the earliest known engine of Hero and its re-invention by Bianca in 1629 were of turbine type, the piston engine being modern and only dating from 1700. Solid fuel engines would be much cheaper than gas engines or oil engines if they could be worked without any trouble from the dust arising from solid fuel.

Mr. Parsons's efforts in improving turbines have been all in the direction of comparatively low speeds of rotation, an end secured by his multiple system of graduated expansion. In condensing turbo-engines of large size, the expansion may be as much as 100-fold, a ratio only possible because at every part of its structure a steam turbine acquires the temperature of the steam at that point, and there is no variation of this temperature. Such turbines have been made to give as much as 1,000 H.P., and sets of 2,000 are nearing completion. It is found that by slight modification in proportions, a centrifugal pump may be made to act up to lifts of 200 feet when driven by a steam turbine.

Screw fans and pumps are made to give economical results by suitable conical diverging outlets and inlets, whereby air or water is led up to the propeller and then made to give up its energy as pressure.

In fast and, so far, small steam vessels much money has been spent on experiments to determine the correct sizes of propellers. It is found best to divide the power amongst two or more turbines driving small propellers. Thus, if three turbines drive three shafts, the arrangement is, in a sense, a triple expansion engine, the three turbines being placed in series, taking the same steam in succession. It is found an advantage to place two propellers of equal pitch on one shaft, so securing ample blade area with small diameter. The cavitation of Messrs. Thorneycroft and Barnaby fixed by them to take place when the mean thrust on the projected blade area exceeds 11¼ lbs. per square inch, has been demonstrated to hold good in the *Turbinia*.

Wide and thin blades of coarse pitch are found best for high speeds. The now historic *Turbinia* is only 100 feet in length, 9 feet beam, and 5 feet draught, and displaces 44½ tons. She has 1,100 square feet of total heating surface, and 42 feet of grate surface. She has three compound turbines, H.P., I.P., and L.P., each driving a shaft with three propellers on it, and she has run 32¾ knots on a consumption for all purposes of 14½ lbs. per I.H.P. of the main engines.

As much as 34½ knots is believed to have been since attained, and she is still the fastest thing afloat. Steam is carried at 210 lbs. in the boilers, and 175 lbs. in the engines; 27 inches of vacuum is secured, so that the expansion ratio is 110. In larger vessels fitted with turbines, the first are two *Viper's* of the destroyer class, and they are expected to have a power of 10,000 H.P. They have an estimated forward speed of 35 knots, and, by means of a smaller turbine, will go astern at 15½ knots. One of these vessels has done a preliminary run at 32 knots. She has two screw shafts on each side. As regards the possibilities of speed in a cruiser of 420 feet × 42 feet × 14 feet maximum draught, displacing 2,800 tons and indicating 80,000 H.P., such a vessel would have eight propellers of 9 feet diameter. They would run at 400 revolutions per minute, the vessel would travel at 44 knots—over 50 miles an hour—and she could steam thus for eight hours. Such a vessel could, therefore, cross to New York in 60 hours of running time, if it could be arranged so that she could be "coaled" at every 400 miles. With oil fuel it may be supposed that runs of 1,000 miles might be possible.

Mr. Parsons considers that the turbine might be applied even to full sized Atlantic liners, with considerable advantage in respect of weight of machinery and economy of fuel. We do not see anything to throw doubt on this expectation.

THE GLASGOW TRAMWAY CONTRACT.

During the recent controversy respecting the placing of the Glasgow Corporation contract for engines for the electric tramway generating station, there was some difficulty experienced by those who sought to get at the root of the matter, but were handicapped by the absence of certain facts, the knowledge of which might have gone a good way toward setting at least some minds at rest. The declaration, which the original recommendation implied, viz., that English engine-makers did not know how to make tramway engines, gave rise to some soreness of feeling, and it was felt that the authorities responsible for that recommendation were not altogether unbiassed in the view they took of the situation. There certainly appeared to be some justification for looking at the matter in this way, with the limited explanations which were vouchsafed, and the criticisms offered by engine-makers in certain quarters.

We do not look upon the upshot of the controversy as by any means unsatisfactory. We had almost said that we would rather have the contract divided in the way it has been than have been given over entirely to one English maker. Certainly one effect will be to place the American and English makers alike on their mettle. If ever English and American firms were placed face to face in competition they are so at Glasgow, and the knowledge of this fact cannot fail to have a corresponding effect upon the engines supplied, as well as upon the time factor. Then, again, when the competing sets are in position at the Glasgow works, we imagine that they will be watched with all-absorbing interest, and many an engineer on the road, after passing the time of day, will inquire the latest performances of the Glasgow engines and generators. We need not attempt to predict what these performances may be, but upon whichever side the advantage lies, we may be sure it will be made good use of in seeking future contracts.

We fully agree with an engineering contemporary that the controversy has been fertile in good results; and it cannot fail to be of value in bringing out ideas and opinions which must bear fruit in future cases.

Those who have followed our articles upon this question somewhat closely should also give attention to the remarks which we are now about to make. They are based upon authoritative statements which have recently been made to us.

We are given to understand that the dimensions of the engines made by the Allis Company nearest in size to the Glasgow engines are as follows:—

High pressure cylinder, 40, as against 42 in the Glasgow specification.
Low pressure cylinders, 58, as against 60 in the Glasgow specification.
Crosshead pins, 10 × 10, as against 12 × 12.
First high pressure crankpin, 10 × 10, as against 12 × 20.
First low pressure pin, 10 × 14, as against 12 × 16.
Second low pressure pin, 10 × 18, as against 12 × 12.

That is to say, the arrangement of the cylinders is reversed from that given in the specification.

There is stated to be a corresponding difference in the dimensions of all the journals, the journals of the Allis Company being designed for a bearing pressure of approximately 150 lbs. per square inch, whereas the pressures in the specification are for approximately 110 lbs. per square inch.

Further, it is said that the high pressure piston rods in the Allis engine referred to above are all 8 inches in diameter, as against 9 inches for the high pressure piston and 10 inches for the two low pressure pistons.

The dimensions of the specification, it seems, are not to be rigorously followed by the Allis Company. The outcome of their consideration is to propose to make the shaft 2 inches larger in diameter than specified. The specification did not contain anything that complied with any standard design of the Allis Company. In fact, the patterns are being made for the engine throughout.

In the Glasgow contract the engines will be stronger in many particulars than is common to American practice, and in other particulars stronger than common to English practice. American practice is for very low bearing pressures and large diameter of shaft, but with relatively smaller crank pins, crosshead pins, piston and connecting rods. The dimensions given in the specification were agreed to by some tenderers as being proper for the purpose, and as representing the best practice.

We believe that in working out the design it was desired to take the strong points of the English engine, and the strong points of the American engine, and embody them in a single machine. Therefore in preventing English makers from adhering to standard practice they were placed on the

same footing as American makers. The final result will be that the bearing pressures will be about three-quarters of that considered common American practice and about a half of that common to ordinary English practice. The bearing pressures on the crank and crosshead pins will be approximately two-thirds of that common to American practice, and practically the same as that common to the best English engine practice. It appears that it was not required that any tenderer should adhere rigorously to the dimensions given in the specification, and, in fact, it is stated that none of the tenders did comply exactly with the specification. The tenders recommended were equal to, or better than, the essential points of the specification. The tenders that were rejected were for engines that by common agreement between best English and American engine makers, it is alleged, could not be made to do the work satisfactorily. Messrs. Musgraves made a mistake in putting in their original proposition, and after this was corrected it seems to us that the entire order would have been theirs, if they could have promised delivery in the time required.

We may be excused for repeating that we are of opinion that the splitting of the order is probably advantageous to the Glasgow Corporation in that both firms are proposing to build machines very much stronger than has been common for traction purposes up to this time; but the advantage will not be confined to Glasgow.

It is now stated that the instructions to the engineer were that no dimensions or specified details were to be embodied as a part of the specification, but that each maker should tender to his own standard designs, it being left to the discretion of the engineer to decide upon the relative merits of the designs submitted. This point has not been generally understood. As usual, the Corporation did not bind itself to accept the lowest or any tender. But in tendering, we believe that the Edward P. Allis Company gave guarantees on steam consumption and delivery which compared very favourably with those offered by English makers; close regulation was not generally objected to.

THE PIDGEON INFLUENCE MACHINE.

Considerable attention has recently been directed to this machine, owing to the circumstance that it is to be used in the Transvaal campaign as a generator of Röntgen rays; one of these machines being included in the Röntgen ray outfit taken out to the front by Major W. C. Beevor, of the Royal Army Medical Corps.

The present Pidgeon machine was first described in a paper read by the inventor, Mr. W. R. Pidgeon, before the Physical Society, October 28th, 1898,* and last summer a very successful machine was exhibited by Mr. Pidgeon at the conversaziones of the Royal Society. This machine is, however, not the first outcome of Mr. Pidgeon's labours in this field. In 1893 he exhibited to the Physical Society† a machine which, though not identical, contained most of the essential features of the machine we are about to describe. These essential features may be shortly specified as, first, improved insulation of all parts of the machine, but more especially the carriers; second, the combination in one machine of the rotating support, and of the fixed support for the inducing charge. The rotating plate as a support for the inducing charge was first employed by Holtz, and has been since employed in several machines, as, for example, in the well-known Wimshurst machine. The fixed plate, as a support for the inducing charge, has been used in machines by Töpler, Holtz and Voss. Mr. W. R. Pidgeon, as far as we know, has been the first to combine these two arrangements in one machine, and the combination, as often happens, has led to important and unexpected improvements. The output of the Pidgeon machine, as we shall see, is many times greater than that of the Holtz, the Voss, or the Wimshurst machine; it excites itself quite as readily as the best of these machines, and it is little affected by unfavourable atmospheric conditions.

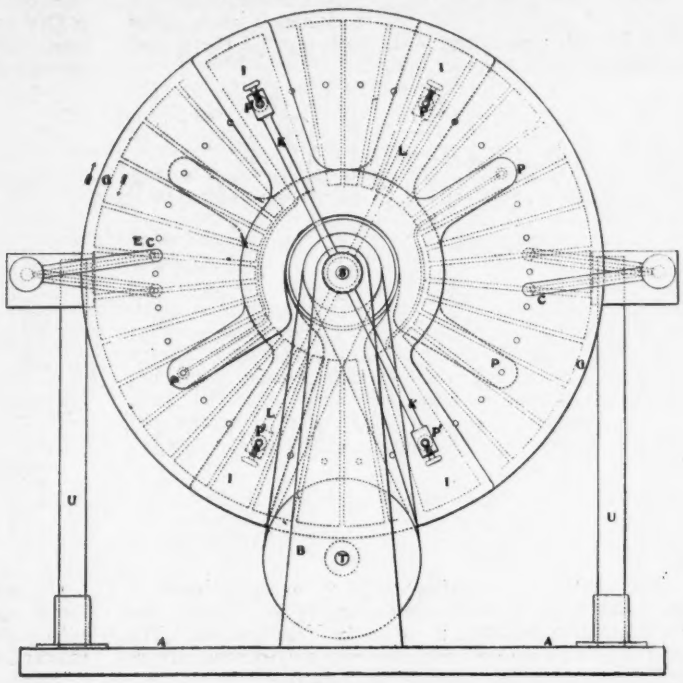


Fig. 1.

Fig. 1 is an elevation of a Pidgeon machine, with two 15-inch rotating discs; fig. 2 is a plan view of the same machine, and fig. 3 is a diagram showing the essential electric organs of the machine, and illustrating the operations by which the electricity is produced. We shall first describe, with reference to fig. 3, the operation of the machine.

In the actual machine there are two glass discs, which are rotated at equal speeds in opposite directions. These discs are represented in the diagram, for convenience, by two circles, G and F, which may be looked upon as the traces of two oppositely rotating cylinders. The arrows show the directions in which the cylinders are supposed to rotate. The pluses and minuses show the distribution of the electricity, E, when the machine is working. Four fixed inductors, I, are placed, two opposite each rotating disc, and these inductors are replenished by small brushes, P, to which each is connected, and which touches the carriers on the rotating discs at the points shown on the diagram. Two transverse conductors or neutralising rods, P^1 P^1, touch the carriers on the discs when they are opposite the centres of the inductors I.

If we consider a carrier on the plate G while it is passing under the brush $P_1{}^1$ on the upper end of the front neutralising rod, we can see that it is almost completely surrounded by two charges of positive electricity, one on the fixed inductor I, and the other on the rotating disc F. The result will be that the carrier in contact with neutralising rod, and consequently at zero potential, will receive almost the highest possible charge at the given potential. Now, in a Wimshurst machine, for example, where the inductor, I, is absent, the charge on the carrier at $P_1{}^1$ would be less than half the amount in Pidgeon's arrangement. To this circumstance (among others) it is due that, for the same size of machine, the output of the Pidgeon machine is so much greater, and that it excites itself so quickly to its full strength. This will be evident if we follow the further course of the carriers after passing the upper front brush $P_1{}^1$. The whole series of carriers equally charged with their practical maximum amount of negative electricity, are moved round, by the rotation of the disc, into a line (shown by the — signs) from $P_1{}^1$ to the brush, C, which takes off the negative charge.

* *Phil Mag.*, December, 1898, p. 564.
† *Phil Mag.*, 36, p. 267, 1893.

Between this line of negative carriers on the front plate and the negative fixed inductor, I, opposite the back plate, each carrier of the back plate is touched by the neutralising brush, P_2^1 as it passes. These carriers in turn receive their practical maximum charge of positive electricity, which reacts on the negative carriers at P_1^1, and so on. The charges accumulate on the carriers in geometrical progression or at compound interest, the peculiarity of the Pidgeon machine being that the ratio of increase or the rate of interest is much higher than in other machines, and, consequently, the capital increases at a much quicker rate.

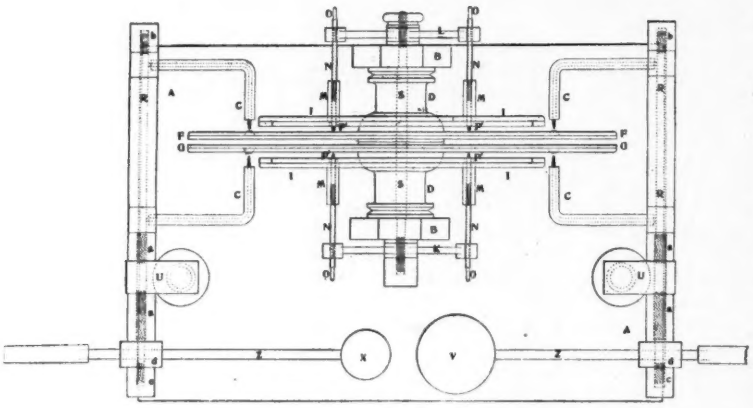


Fig. 2.

The negative carriers after passing P_2^1 touch the brush, P, and communicate a small negative charge to replenish the front negative inductor, I, as in the Voss machine. The negative charge is then completely removed from the carriers by the brushes on the negative electrode, C.

An exactly similar series of operations takes place on the other half of the machine, with the result that positive electricity is discharged to the positive electrode, C.

In the actual machine, figs. 1 and 2, we have as far as possible designated similar parts by the same letters used in the diagram, so that it will only be necessary to describe the details of the construction of these parts.

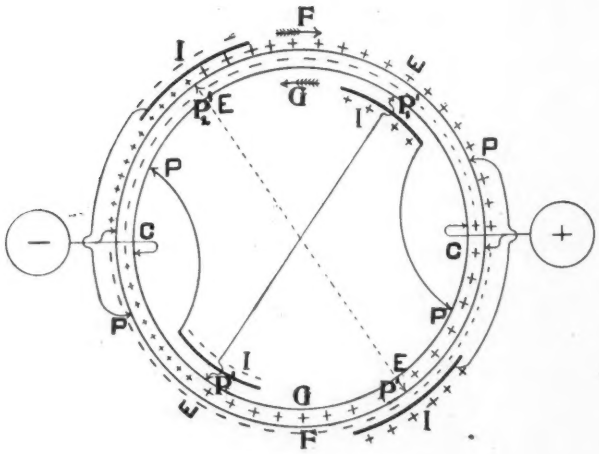


Fig 3.

On a wooden baseboard, A, are erected two tapering supports, B, through which is passed a steel spindle, S, which is clamped by nuts to the supports, as shown in the plan, fig. 2. On this fixed spindle the bosses, D, of the two discs, F, G, are rotated in opposite directions by an open and a crossed belt from pulleys on the driving axle, T. The neutralising rods, K, L, are mounted on the projecting screwed ends of the spindle, S, and clamped at a suitable angle by nuts, as shown. The fixed inductors, I, which are of tinfoil, are pasted on the back of a peculiarly shaped piece of vulcanite with four radial horns and a gap, by which it can be easily removed from the machine along with the neutralising rod by which it is supported. There are two of these vulcanite plates, one on each side of the machine. The construction and mounting of these vulcanite plates is best seen in the plan, fig. 2. The tinfoil sectors are pasted on the side of the vulcanite plate away from the rotating discs; they are then coated with a thick layer of resin and paraffin wax mixed in equal parts, with the view of preventing leakage from the inductors.

The horizontal extensions, N, of the neutralising rods, must, of course, be thoroughly insulated from the inductors through the centres of which they pass. This is effected by short, thick pieces of vulcanite tube, M, which are shouldered and screwed into the vulcanite plates, through holes cut in the tinfoil. The brushes, P^1, which make contact with the carriers, are fixed on the ends of brass rods, O, which are pushed through the brass tubes, N, till the brushes just touch the brass knobs on the carriers.

The carriers are sectors of tinfoil, which are pasted on the outside of the glass disc, each sector being separated from the next by about $\frac{1}{8}$ inch of bare glass. Over the sectors is poured the insulating layer of resin and wax already described. It would be impossible with the ordinary machines, such as the Voss or the Wimshurst, to place the sectors so close together as in the Pidgeon, since the leakage would more than counterbalance the advantage of the greater surface. The superior insulation in the Pidgeon machine contributes not a little to its large output.

On each carrier is fixed a hemispherical brass knob, the top of which just projects from the layer of wax and resin, sufficiently to be touched by the brushes of the neutralising rods and the electrodes.

All the metallic parts of the electrodes or collectors, C, are encased in vulcanite tubing. The collecting brushes are mounted on the ends of bent brass wires, which pass through bent vulcanite tubes to the brass rods R. The rods, R, are clamped to the standards, U, by vulcanite nuts *a*, screwed on a thicker part of the rod. The rods, Z, on which the discharge knobs, X and Y, are fixed, slide in vulcanite washers *d*, contact with the rod, R, being secured by a short spiral spring. The whole of the vulcanite washers and tubes covering the rod, R, are clamped together by the screwed vulcanite caps *b* and *c*.

The following are a few practical hints kindly supplied by Mr. Pidgeon, which will be of value to those who propose to make this machine:—Put on the sectors with gold size; earthing brushes should be very tiny, like small paint brushes; tiny brushes or knobs may be used on the collectors; wash the discs with paraffin before flooding with wax; heat discs also before flooding; $\frac{3}{16}$-inch ebonite of inductors towards disc, wax outside; collecting points for inductors flush with face of ebonite, so as not to scratch wax; contact knobs on sectors small, smooth, and round, projecting slightly above wax; earthing brushes should barely touch; position of earthing brushes, collectors, and exploring points as shown on drawing; all the glass must be good non-conductor, not like a great deal of the German glass, which is a moderately good conductor; paraffin with a melting point of 170° should be used, and the best resin to mix with it is what they call "golden resin." It is purer and cleaner than the ordinary stuff; mix in equal weight.

To show the relation of the output of the Pidgeon machine to that of some of the better-known influence machines already in use, we give the curves shown in fig. 4. These curves are drawn from experiments made partly by Schaffers and partly by Mr. Pidgeon. They are only to be taken as approximately correct, since the output of influence machines depends so much on careful construction and on the atmospheric conditions, that different results may be obtained from the same machine under different circumstances. The experiments, however, were made with great care, and may safely be taken as average results. The horizontal ordinates indicate the length of the spark, and the vertical ordinates the number of sparks from a unit condenser, reduced to a unit area of a rotating disc passing a diametral plane.

The curve marked P is for a Pidgeon machine; V, for a Voss; H, for a Holtz with fixed inductors; W, for a Wims-

hurst; B, for a Bonetti machine with ebonite discs and sectors; B^1 for a Bonetti machine without sectors.* It is evident from these curves that for sparks of moderate length the output of the Pidgeon is very much superior to all the other machines; for long sparks, the Bonetti machine without sectors appears to have the advantage. The output of all these machines appears to fall off very rapidly as the spark length increases.

It has been stated more than once lately that the Pidgeon machine was merely a modified form of the Wimshurst

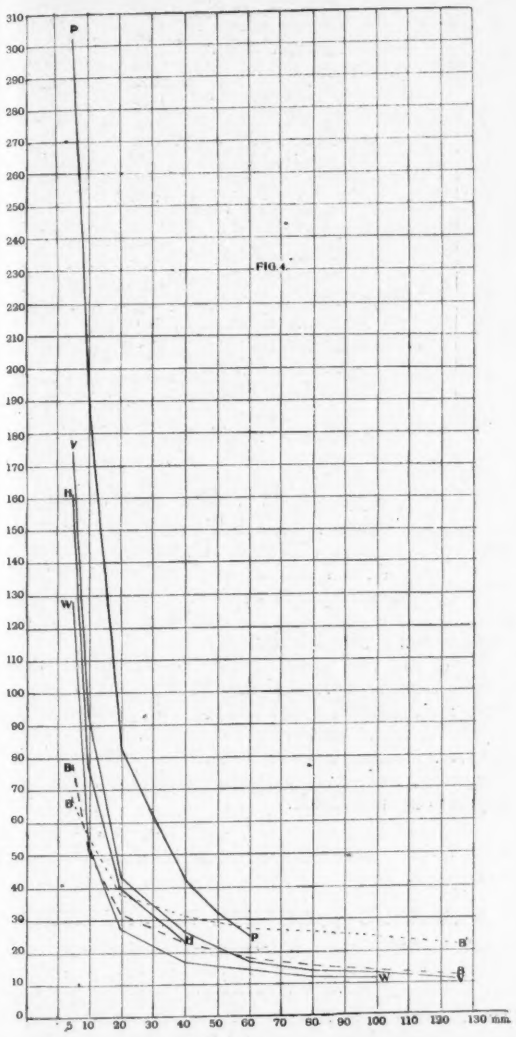


FIG 4.

machine. It will be seen from the above description that there is not the slightest foundation for this assertion. The impression no doubt arose from an imperfect or superficial knowledge of the Pidgeon and the Wimshurst inventions, and from the fact that oppositely rotating plates are used in both these machines. But the oppositely rotating plates were invented and described by Holtz in 1869, 14 years before the invention of the Wimshurst;† consequently it is Holtz and not Wimshurst that Mr. Pidgeon has to thank for this part of his invention. But Mr. Pidgeon's invention, we take it, is for the combination of two previously well-known types of influence machines; a combination which has justified its invention by the excellent results it produces. Mr. S. Bottone, in a letter to the *Daily News* of November 2nd, asserts that he was the first to point out (*English Mechanic*, April 3rd, 1896) the great advantages of the "Wimshurst" for X ray purposes. Mr. Pidgeon's machine not being a "Wimshurst," Mr. Bottone's claim as far as regards Mr. Pidgeon becomes irrelevant. Mr. Pidgeon, we are sure, makes no claim to be the first to have applied the influence machine for X ray purposes (that was done by Dr. Pupin as early as March 13th, 1896, see ELECTRICAL REVIEW), but what we think Mr. Pidgeon has done is to create an entirely new influence machine apparently better adapted for X ray purposes than any of the existing influence machines.

* "Machines Electriques à Influence," par V. Schaffers, p. 103.
† ELECTRICAL REVIEW, vol. 42, page 685.

A REPEATER FOR USE IN WIRELESS TELEGRAPHY.

MESSAGES have been transmitted in England by the Marconi system of wireless telegraphy over a distance of 90 miles. This may not yet be the limit for direct transmission, but even in ordinary telegraphy there is a limit to the distance over which a message can be directly transmitted. Very long lines can only be worked by the help of repeaters, which automatically receive and re-transmit the messages by means of a local battery. If this principle could be applied to wireless telegraphy, its range might be immensely increased. An ingenious arrangement, designed to act as a repeater in wireless telegraphy, has been devised by Emile Guarini-Foresio. We do not know whether it has worked successfully in practice, but it looks as if it ought to.

Fig. 1 is a diagrammatic view of the arrangement of the

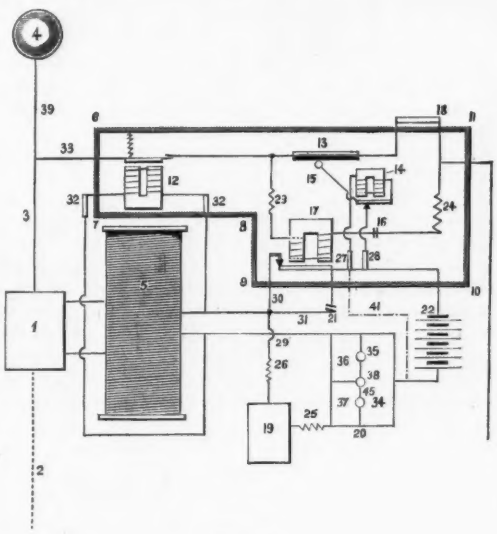


FIG. 1.

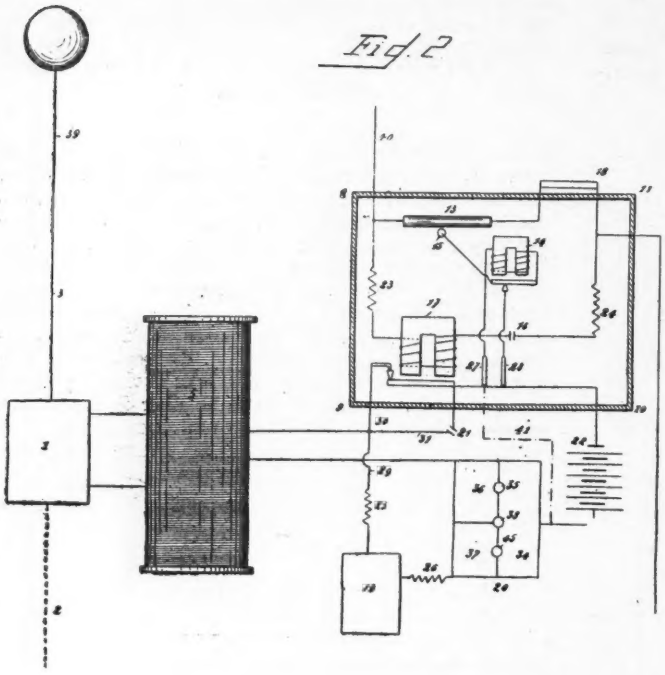
connections of one of these Foresio repeaters. The oscillator 1 is connected on one side, 2, to the earth, and on the other, 3, to the aerial conductor, terminating in a sphere, 4, of considerable capacity. The oscillator is fed by an induction coil 5. In a box, 6, 7, 8, 9, 10, 11, of soft sheet-iron, are enclosed:—an electro-magnet 12, which, every time the oscillator works, breaks the communication between the wire 3, and the sensitive tube or coherer 13, the sensitiveness of which is otherwise changed; also the vibrator 14, the hammer, 15, of which strikes and decoherers the sensitive tube 13, situated in the local circuit 16; lastly, the relay 17, and a galvanometer 18, the needle of which indicates whether the apparatus is working. The Morse instrument 19, lies outside the metal box; at 20 is a three-way switch, at 21 the switch, and at 22 the battery; 23, 24, 25, 26, 27, 28, 32 are resistances.

The conductor 29 is in connection at 30 with the conductor 31; a variant of the shunt containing the vibrator, 14 consists in placing a conductor 41 of the said circuit of the vibrator upon the conductor going from the battery 22 to the commutator 20.

The repeater can work as a transmitter, as a receiver, or as a relay. In order to make it work as a transmitter, it is necessary to close, by means of the switch 21, the circuit

containing the battery 22, the primary of the bobbin 5, the shunt circuit containing the vibrator 14 (when the connection shown at 41 is used, the hammer of the vibrator works continuously); in this case, the plate 34 of the commutator is in communication with the plate 36 through a plug placed in the hole 35. When the apparatus is working as a

Fig. 2.



receiver, the electric waves picked up by the rod 39 are transmitted by the wire 33 to the coherer 13; what follows is the same as in the Marconi receiver; all that is necessary is, that the plate 34 be in communication with the plate 37 by means of a plug placed in the hole 45. When the apparatus works as a repeater, the events succeed each other as in the preceding case, but the relay 17, when it attracts its armature, instead of closing the circuit of the Morse instrument, closes the circuit of the coil which feeds the oscillator.

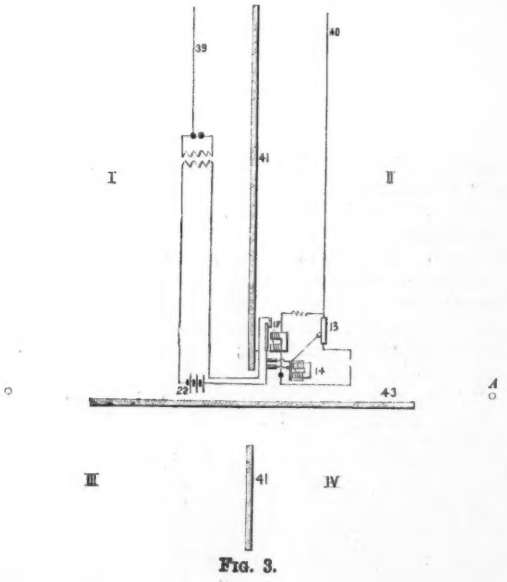


Fig. 3.

All that is necessary is to connect the plate 34 of the commutator to the plate 36 by the plug 35. If, in addition, the conductor 34 is connected with the conductor 37, and also with conductor 36 by the plug 38, this simple arrangement ensures that the signals are both registered and repeated. Since the electro-magnet, the relay and the coherer are enclosed in an iron box, these parts of the apparatus cannot be influenced by the magnetic field of the induction coil.

Instead of one vertical conductor two may be employed; one 39 in communication with the oscillator 1, and the other 40 in communication with the coherer 13, thus suppressing the electro-magnet 12.

The repeater just described is specially adapted for movable stations, for instance, in establishing communication between three ships, one of which is the intermediate station.

In the case where the repeater has to serve two stations, A and B, on *terra firma*, or in the case where several relays are employed between the two terminal stations, the repeater already described engenders confusion of signals, and the arrangement in fig. 3 is employed.

The receiver is here separated from the transmitter by a metallic partition, 41, the receiver being on the side of the terminal transmitting station, and the transmitter on the side of the terminal receiving station.

The partition prevents the radiations of the transmitter of the intermediate station returning on the terminal transmitter, or upon a preceding intermediate station. The partition, 41, may also act as a reflector.

The organs, I. and II. (fig. 3) are arranged to receive electric waves from A and transmit them towards B. To receive radiations from B and transmit them to A a second apparatus should be employed, quite distinct from the first, the organs of which are also separated by a partition, 41. In the second apparatus the receiver will be at III., and the transmitter at IV., and the two combinations are separated by a third partition, 43, which allows one only of the two to work, according as the station A or the station B is transmitting.

We doubt very much if the metallic partitions in the Foresio repeater will be effective in screening off the electric waves; or, at least, if efficient for that purpose, they would require to be of an impracticable size. This invention, however, professes to solve an important problem in wireless telegraphy, and seems to contain some ingenious hints that may help to its solution.

ELECTRIC LIGHTING IN SHOREDITCH.

Allocation of the "Profits."

The members of the Shoreditch Vestry were, on Tuesday, presented by the Lighting Committee with a report dealing with the question of the allocation of the "electricity surplus" for the past financial year. Mr. H. Winkler was early on the scene, looking for the profits which he was unable to discover, and he was only quietened on being informed that someone had gone to fetch them. Even Mr. Russell and Mr. Adams appeared with such beaming countenances as to foreshadow a lively meeting; but after all, everyone was disappointed, owing to the adjournment of the debate. We give below the report of the Committee.

The Disposal of the Profits.

The Committee stated:—

That your Committee, after very careful consideration of all the circumstances relative to the allocation of the available surplus of the electric lighting undertaking, amounting to £6,463 10s. 8d., think—in the first place—that all monies received as contribution from the rates since the inception of the electricity undertaking (being chiefly repayment of debt and interest before the works were commenced) should be repaid to the rates. This item, which is £1,255 8s. 2d., represents deficiencies in years ended March 25th, 1895-6-7 (see page 37 of 1899 accounts). On this repayment being made, no monies from the rates will be involved in the undertaking either on maintenance or capital account, as all capital has been provided for out of borrowed money.

In the second place, your Committee think the fairest way of recompensing the dust destructor undertaking for steam supplied from the waste heat obtained from the parish refuse is for the electricity undertaking to pay a sum equal to the cost which they would have incurred had the electricity been generated from coal, and from the average of 17 metropolitan stations, your chief engineer states that the cost of coal is about 1d. per unit on the total units sold, the other costs of handling the fuel, &c., being already fairly apportioned to the Electricity Department. On this basis, the cost to the electric lighting undertaking would amount to £4,297 5s. 8d., and after deducting from that sum the amount already spent for coal, viz., £1,375 13s 6d., there appears a balance of £2,921 12s. 2d. to be credited to the dust destructor accounts as representing the full value of the steam supplied to the electricity undertaking. This payment would still leave a deficit in the dust destructor accounts of £694 10s. 4d.,

against which, your Committee think it equitable, that the value of the steam supplied to the baths and wash-houses should be set, as from the estimate of Mr. Manville (see p. 3 of the Annual Report for year ended March, 1898) it would have cost the baths more than this sum for all charges in connection with the heating of the baths and wash-houses by separate boilers.

In view also of the saving to the rates during the past year of over 1s. per ton, or £1,186 8s. 11d., on the parish refuse burnt, from the previous cost of barging, your committee think that the electricity undertaking should not be further saddled with the cost in past years of a distinct branch of the municipal service, such as dust disposal, which is payable out of the general rate and not legally chargeable to the lighting rate.

The above proposals will dispose of the deficit on the dust destructor account.

In the third place, your Committee has considered an application from the Library Committee for a grant toward the cost of the Public Libraries, which have been charged £243 9s. 9d. during the past year for electricity supplied them, and in view of the generally recognised difficulty in maintaining the two libraries from a rate limited to ¾d. in the £, your Committee unanimously agreed to allocate £250 out of the surplus of the electricity undertaking to the Library Committee's account. In the fourth place there will be still left after paying the three sums above mentioned an available surplus of £2,036 10s. 4d., out of which your Committee think it best to apply £1,000 to a reserve fund, and, in view of the heavy outlay which will be incurred on the proposed new station (which will not be running for some time) think it advisable that the balance of £1,036 10s. 4d. be carried forward to next year's accounts.

Your Committee therefore recommend:—(1) That the sum of £1,255 8s. 2d. be paid by the electric lighting revenue account out of the electricity surplus to the credit of the general rates, which sum represents all monies heretofore advanced from that rate to the electric lighting undertaking. (2) That the sum of £9,921 12s. 3d. be paid by the electric lighting revenue account out of the electricity surplus to the dust destructor revenue account, and that the deficiency, amounting to £694 10s. 4d., on the dust destructor revenue account be written off as the value of steam supplied to the baths and wash-houses. (3) That an order on the treasurer be signed for £250, to be paid by the electric lighting revenue account out of the electricity surplus to the credit of the public libraries revenue account, independently of their income from rates. (4) That the sum of £1,000 be transferred from the electric lighting revenue account to a reserve fund, to be called the "Electric Lighting Undertaking Reserve Fund," and that the amount be placed on deposit at the Vestry's bankers on the best terms as regards interest obtainable. (5) That the balance of £1,036 10s. 4d. be carried forward to next year's accounts. (6) That to avoid dislocation of one quarter's rates by the receipt of the items under the first and second heads, which form a total of £4,177 0s. 4d., or nearly 1¼d. in the £, this sum should be paid by four quarterly instalments, and that an order on the treasurer be now signed for £1,044 5s. 1d. (the first of such instalments) in favour of the general rate out of the electric lighting revenue account.

Mr. N. Moss, chairman of the Committee, formally moved the adoption of the recommendations.

Mr. J. J. Freeman raised a protest against the statement in the report that a saving of 1s. per ton had been effected over the previous system of disposing of the refuse. It was an assertion which no member of the Vestry could claim to be a fact. The cost of carting the refuse to the destructor was much higher than previously, and instead of four loads being collected daily, only three were unloaded at the destructor.

Mr. Wells asked where the £6,463 profit was at the present time?

Mr. H. Winkler asked whether the Vestry would be the laughing stock of the world again. He thought they ought to come to some practical settlement of the question. There had been a profit of £6,000 on the Lighting Department, and a loss of £8,000 on the destructor; let the one be set against the other. As an amendment he moved that the profits on the lighting station should be used for the purpose of liquidating the losses on the destructor.

The further debate of the question was adjourned.

CORRESPONDENCE.

Penalty Clauses.

The aspect of penalty clauses has been recently defined in your columns from a legal point of view; but it might be of some service to consider the matter from an ordinary layman's standpoint. In the performance of any work, whether it be engineering or in a business that comes under the generic term of commerce, the time element is one of supreme importance. It is, in point of fact, one of the essentials of commercial and industrial life, and without it no business could be expected to flourish. In the completion of a specific contract, one of the principal conditions naturally relates to the time in which such a contract will be fulfilled, and there is nothing unreasonable in such a stipulation. In common with a practice followed throughout the whole of the engineering and the allied industries, specifications for electrical plant invariably include a clause relating to the time of delivery; they moreover specifically state that certain penalties will be exacted if the conditions of delivery are not complied with. It is an unmistakable fact that these stipulations have been held more in the breach than in the observance, and I am afraid that the very leniency which has been displayed by the purchasers of electrical machinery has not led to any improvement in the time of delivery. I am not for a moment suggesting that the electrical manufacturers do not use their best endeavours to carry out that part of the contract, but, as a rule, they fail lamentably. It is apparent that the generous treatment accorded to electrical contractors by manufacturers and supply companies has produced an effect which is inimical to the best interests of the industry. There are doubtless many who imagine that penalty clauses are not likely to be insisted upon. Moreover, I believe there is a widely prevailing notion that penalty clauses cannot be legally enforced. How completely wrong this latter view is was clearly demonstrated in your article in the issue of the 27th ult. Assuming, however, that there had been some difficulty in enforcing these clauses, it would hardly be creditable for a manufacturer to take advantage of a legal difficulty, and, as a rule, I do not think such conduct could be ascribed to him. The one conspicuous fact, however, in the carrying out of electrical work is, that contractors are, for the most part, behind the specified period of completion, and one is almost irresistibly forced to the conclusion that contracts are undertaken without any regard to the time in which they can be completed. It is unnecessary to insist upon the bad influence such a proceeding must have eventually upon the whole of the profession. There seems to be a probability, and by no means a remote one, that the question of enforcing penalties is likely to come before the Courts, and though, at the moment, it is a little difficult to see on what grounds the case will be fought, I do not think there can be much doubt as to the result, assuming always that the penalties themselves were reasonable. In the enforcement of penalty clauses there is always the difficulty of proving damages, but without endeavouring to estimate to what extent damage is caused to the purchasers of electrical machinery by the non-fulfilment of contracts, there is not the slightest doubt that the failure to keep time is operating most disadvantageously, not only in electric lighting, but also in tramway work. The non-compliance with the terms of a contract means not only that the buyers become disgusted, but in a measure it affects the interests of the general public. Most electric lighting works, at the moment, have arrived at the position of being quite unable to add new consumers to the mains on account of the lack of machinery. But though potential consumers may be put off for some weeks, it is not unlikely that if these weeks extend into months, they may have cooled off very considerably, and will be inclined to stick to gas. Gas is an objectionable illuminant, but it must be admitted by impartial observers that the many improvements effected in burners during the past three or four years has made it more tolerable for illuminating purposes, and with the great activity displayed by the gas companies and burner manufacturers, it would be unfortunate if we are unable to meet with some readiness the demands for electric lighting that are arising.

As you have said, municipalities and supply companies are not inclined to adopt harsh measures against contractors, because they fully admit some of the difficulties that exist. At the same time, if they receive a definite promise from a dynamo or engine builder, they make their arrangements accordingly, and it needs no very keen imagination to picture the inconvenience that is bound to arise if these arrangements go wrong. The gist of the matter is, that the manufacturers should not promise to deliver plant if there is the slightest doubt in their minds. I am quite aware of the fact that, if one manufacturer did not promise delivery in a given time, it would not be difficult to find other contractors quite willing to make promises. Promises without performance are always bad, and you have endeavoured to show the disastrous effects which they are working in the development of electrical engineering. In a sense, one almost welcomes the action which, I believe, is likely to be taken in this matter, because it will have the effect of clearing away a good many misconceptions that prevail on the subject of penalty clauses, and it will certainly have a marked influence on the specific fulfilment of contracts. It may result in contractors refusing to deliver under a certain time, but there will be the corresponding advantage of knowing that, in all probability, the plant will be up to time; whereas we are now promised early delivery, and invariably the machinery is many weeks over due when it is erected. I do not, for a moment, suggest that electrical manufacturers are alone in failing to keep pace with their promises, for there is little doubt that many other branches of engineering are in a backward condition; moreover, the late delivery of electrical plant is, in some cases, due to the delay that arises in getting raw material. Still, these are things which the contractor has to reckon with, and, in tendering, he must take into account causes that may tend to make him late.

Observer.

The Pimbley Economiser.

We hope you will allow us to say a few words on the remarks respecting this economiser in your issue of the 3rd.

First, we would say that we command an experience of the working of this economiser extending over four years, and therefore have time on our side to demonstrate what does or does not happen: and as some of the earlier economisers were put in in a very crude manner, and are working under the worst possible conditions, there have been some severe tests as to what can happen. Upon the important question of scaling or choking up we would not say that the freedom from scale and deposits is altogether due to the velocity of the water passing through the pipes, but believe other elements help to bring about this desirable result, one of these being that the water, travelling as it does gradually from one end of the apparatus to the other, would not attain that temperature which is necessary for the deposits to be thrown down until it reaches the last few pipes, and then they would not be given off in a way to scale and choke before entering the boiler, where evaporation takes place.

We do not advance the theory that rapidity of flow of water will prevent scale or choking up of pipes under all conditions of heat, or any conditions, of evaporation, and contend that the choking up of the feed distribution pipes in boilers—the very point at which evaporation begins to take place—cannot in fairness be brought in as a comparison. Here is an analysis of water with which a Pimbley economiser has dealt for four years without being once cleaned out, and from which pipes have been removed from time to time and found perfectly clean.

The following is the analysis of water passing through the economiser erected at Messrs. Porritt Bros., Bridgewater Mill, Farnworth, four years ago :—

Results Stated in Grains per Imperial Gallon.

1.—Total Solids.		3.—Hardness, degrees.	
Mineral matter ...	28·7	Temporary	2°4
Organic and volatile	9·3	Permanent	11°0
Total ...	38·0	Total ...	13°4
2.—Mineral Matters.			
Silica	2·10		
Iron oxide and alumina	2·50	4.—Solids. Per ton of coal...	9·95 lbs.
Carbonate of lime and magnesia ...	24·0		
Sulphates	14·96		
Sodium chloride ...	4·10	5.—Solids. Per week ...	199·5 lbs.
Sodium sulphate and loss by difference...	2·64		
Total ...	28·70	6.—Solids. Per month ...	798 lbs.

The above calculation as to the amount of solid matter passing through economisers is based on the boiler evaporating 8 lbs. of water per pound of coal.—T. Aspinall, Analytical Chemist, Farnworth.

May we also point out that the ordinary economiser cannot be made into a circulating one, such as the Pimbley, its form of construction making it impossible.

In conclusion, will you allow us to say we are prepared to back our experience so far as to put down economisers in the worst districts in England on the "no cure, no pay," principle.

Jas. Carter & Sons.

Stalybridge, *November 7th*, 1899.

Arc Lamps and How to Maintain Them.

I have read with interest your criticism and the authors' answer thereto on the book, "Arc Lamps and How to Maintain Them." I am quite in accordance with you in maintaining that $\frac{3}{32}$-inch is much too short for an open arc. Moreover, the chance remark of the authors with reference to the Manchester arc lamps, explains to me what I have always considered the remarkably poor light given out by the Manchester arc lamps, more especially those on private circuits such as outside shop windows. If all these lamps are set to burn with $\frac{3}{32}$-inch arc, I think you will agree with me that the poor light requires no further explanation.

An Electrical Engineer.

November 6th, 1899.

Babcock & Wilcox Superheater.

With reference to your article on above, and the letter by Mr. Tatlow this week, it is pointed out by Mr. Tatlow that the formula $\frac{T_1 - T_2}{T_1}$ is not applicable to the case of superheated steam, since the heat is taken in at different temperatures. He, however, working out from quantity of heat supplied, obtains an increase of efficiency of 2 per cent. in a way not quite obvious. A more satisfactory method of comparing the two results obtained, with and without superheated steam, would be by comparing the thermal efficiencies, with the engine assumed to be working on a Clausius cycle. The formulas for engines on this cycle are :—

1st efficiency (without superheated steam)

$$= \frac{[T_2 - T_1]\left[1 + \frac{L_2}{T_2}\right] - T_1 \log_e \frac{T_2}{T_1}}{T_2 - T_1 + L_2}.$$

2nd efficiency (with superheated steam)

$$= \frac{[T_2 - T_1]\left[1 + \frac{L_2}{T_2}\right] + \cdot 48\,[T_3 - T_2] - T_1\left[\log_e \frac{T_2}{T_1} + \cdot 48 \log_e \frac{T_3}{T_2}\right]}{T_2 - T_1 + L_2 + \cdot 48\,[T_3 - T_2]}.$$

Where the following are absolute temperatures

T_3 = superheated steam (462° F.).
T_2 = boiler steam (337° F.).
T_1 = exhaust (212° F.).

Working out we get

1st efficiency = ·141 ;

2nd efficiency = ·1535, an increase of 1·25 per cent. of efficiency, or an improvement of about 8·9 per cent., and not 72 per cent. as calculated from a consideration of Carnot's formula, which must clearly be wrong in this case, since it assumes a cyclic action, and the heat all supplied at one temperature.

James C. Small.

November 4th, 1899.

Re Answers to Situations Vacant Advertisements.

I was much interested by the paragraph on the above subject, which appears in the Electrical Review of November 3rd, 1899. In this day of "Employers' Federations," when inquiries and answers respecting this and that workman, pass and repass between the various employers of labour, is it any wonder that a man *in work*, on applying for an advertised post, which may be (according to the advertisement) a decided improvement for him, is afraid to "show too much of his hand"?

Personally, I should be glad if I could accept your assurance that all the information asked for by advertisers is treated by them as private and confidential. With some firms I've no doubt this is so, but I'm sorry to be forced by circumstances to believe that with many firms this is not so, and there have been cases where the information given by an applicant has been used to his detriment. This lack of *faith in the advertiser*, the fear that were the desired information given, the advertiser might communicate with one's present employer, is, I suppose, practically the only force at work which makes applicants occupy the position complained about. So long as an advertiser is not prepared to declare himself in a more recognisable form than as "Box No. So and So, Electrical Review," so long may he expect incomplete applications. I've known cases of men actually applying to their own employers through the adoption of these artifices, and in some cases this would bring about instant dismissal.

Let the advertiser set the example by declaring his true identity. He will then receive fewer, perhaps, but more complete applications.

Commercial.

[There are black sheep in every fold, but we do not think electrical employers as a rule are open to the sweeping charge of breach of confidence which is made by "Commercial."

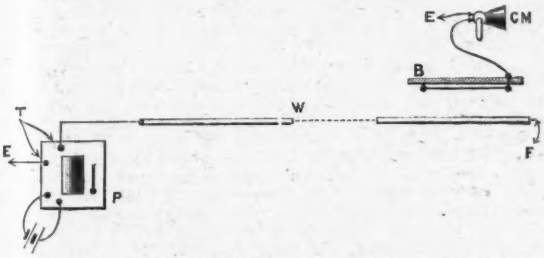
The man desiring a change can safeguard himself against any possible irregularities of this kind by requesting the advertisement manager of the ELECTRICAL REVIEW not to forward the letter of application if the advertiser is known to be such and such a firm. This is no uncommon occurrence, and it is a very simple procedure. The applicant may be pretty sure that our own advertisement department is beyond reproach in this respect. We are inclined to believe that the man who withholds necessary information stands to lose more than the employer who desires it. Finally we would add "Nothing venture, nothing win."—EDS. ELEC. REV.]

Telegraphing to Trains in Motion.

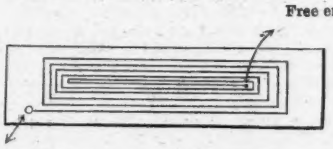
In connection with the investment of Mafeking, mention was recently made of communication having been established between an armoured train and the town by means of the phonopore telephone. There was nothing probably very special in this, but it gives rise to the thought as to what might be the advantage of being able to communicate with the armoured trains when they were in motion. It is doubtful whether this could be successfully done by the Marconi system, but an experiment which I made a short time since leads me to believe that such communication could be most simply established by working on the phonoporic system.

My experiment was purely a laboratory one, and was made as a preliminary towards seeing if it was possible to communicate with a driver of a train by means of the note of the phonopore transmitter, or of an ordinary induction coil.

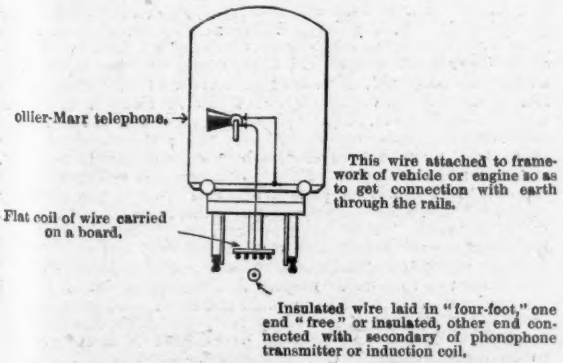
In one room I had a phonopore transmitter, one of the secondary terminals of which was connected to earth, and



T, Secondary terminals; P, Phonophone telegraph transmitter or induction coil, with Morse key; W, Insulated wire; B, Board, with flat coil of wire attached; C M, Collier-Marr telephone; F, Free end.



FLAT COIL OF WIRE ON BOARD.


ollier-Marr telephone.
This wire attached to framework of vehicle or engine so as to get connection with earth through the rails.
Flat coil of wire carried on a board.
Insulated wire laid in "four-foot," one end "free" or insulated, other end connected with secondary of phonophone transmitter or induction coil.

the other to an insulated wire which reached into an adjoining room. The other end of this wire was left free or insulated. This comprised the transmitting circuit. The receiving circuit consisted of a flat coil of wire, on a board about 4 feet in length, one end of this coil was left free, and the other end connected to the earth through a Collier-Marr receiver.

By placing the flat coil over the wire connected with the transmitter, signals could be distinctly read in the telephone when the distance between the coil and the straight wire was as much as 12 inches.

I enclose a rough sketch of the experiment I made, and also one showing how I think it could be turned to practical account.

The reason I did not continue the experiments was, that the practical advantage of giving such a communication was not sufficiently apparent, that was for the particular purpose I had in view.

The arrangement I have shown, would, it is clear, I think, require but little modification to make it available for communicating either way.

C. M. J.

Signalling Without Contact.

If permissible, I should like to offer a little criticism on the paper read by Mr. Boult before the British Association, and which recently appeared in the ELECTRICAL REVIEW.

Mr. Boult makes a statement with regard to the present fog-signalling system, which is calculated to convey a wrong impression. He speaks of the driver assuming that the line is clear if he does not hear a detonator explosion. This is not substantially correct. What a driver assumes on approaching, or passing, fixed signals which cannot be seen in dense fogs, is that the fixed signals are at danger, unless he sees the fogman's green hand-signal. It is a mistake to suppose that, in a fog, a driver goes blundering on, relying absolutely upon the explosion of a detonator to acquaint him of danger. If such was the case, could the late Sir George Findlay have written *in the highest praise of the results attained?*

Mr. Boult aims at giving, what, perhaps, no other inventor has previously seriously attempted, an *invariable danger signal.* This is most essential, although what would be better still would be an *invariable danger signal except when an all right signal is to be given.* A danger signal and an all right signal in quick succession may be confusing. But can Mr. Boult claim an invariable danger signal? Can no circumstances be conceived in which his danger signal would not be invariable? Must not his danger signal, if his system is to come up to Board of Trade requirements, give a *nearer* approach to absolute certainty than may be attained by fallible humanity? Can the duplication of fundamental parts be said to constitute certainty? The necessity for duplication implies uncertainty. The analogy of the detonator does not strictly apply. Nothing can be much simpler than a detonator. And because the failure of two such simple things may be remote, it does not follow that the same degree of remoteness applies to Mr. Boult's system, for the fundamental parts of his apparatus are numerous, and nearly all more liable to failure than a detonator, consisting as they do of pivoted movements, tremulous bells, and battery cells, each in turn having fundamental parts. Nor does it appear that all the fundamental parts of Mr. Boult's apparatus are in duplicate. The little semaphore arms are not. Moreover, are the permanent magnets on the road invariable? May they not lose in power in course of time?

I do not understand how Mr. Boult can claim simplicity for his system. The fundamental principle is simple, but there is nothing simple about the apparatus and its circuits. In fact, the system would practically convert the cab of the engine into a signal box so far as electrical apparatus goes. The driver of an express train would require a man to attend to the signalling apparatus. Taking a length of line, with four block sections to the mile, and a train moving at 60 miles per hour, the driver, in one minute, would probably receive 30 signal indications, without counting duplicate spots and route indications. But what I think would be worse, would be the liability of the indicator being misread. With the road blocked ahead, the driver, when inside the distant, and before reaching the warning magnets, would have his home semaphore showing off, and inviting him to run on.

Then as regards the route indications. Is not Mr. Boult wrong in suggesting that the worst results of a driver thinking he was on the right road when he was not, would be loss of time? What if one of the roads was to a bay platform?

Mr. Boult's route indicators are dependent upon electro-magnets on the road, and consequently liable to failure, and to give wrong indications—a serious matter.

How is Mr. Boult going to deal with single lines? On many trunk lines there are short sections of single road.

Mr. Boult has referred to the different senses which fail to do all that is wanted, according to his standard of requirements, and, in conclusion, I would point out that there is one important sense, which the introduction of his system, or, in fact, any other mechanical system, would soon destroy, that is, the sense of alertness to danger, which is the secret of the success of the present system.

C. M. J.

LEGAL.

Electric Construction Company *v.* Imperial Tramways Company, The British Thomson-Houston Company (Third Parties).

This case was commenced on Tuesday before Mr. Justice Cozens-Hardy in the Chancery Division. It was an action brought by the plaintiffs for an injunction to restrain the defendants, their servants and agents, from infringing the letters patent granted to Thos. John Handford, No. 9,527 of 1885, of which the plaintiffs were the holders. The infringement complained of was the use of electric motors supplied by the defendants on the Middlesbrough, Stockton and Thornaby tramways. The British Thomson-Houston Company were added as third parties, but they were treated as defendants. The patent sued upon having expired, the plaintiffs asked for damages in lieu of the injunction they claimed in their writ.

Mr. Fletcher Moulton, Q.C., Mr. Bousfield, Q.C., and Mr. Grey appeared for the plaintiffs; and Mr. Cripps, Q.C., Mr. Astbury, Q.C., and Mr. A. J. Walter for the defendants and third parties.

Mr. Moulton, in opening the case, said the patent of Mr. Handford related to dynamos or motors mounted on cars or carriages for the purpose of propelling them. The invention was a special way of mounting electric motors so as to obviate very great inconvenience which would otherwise be met with in connection with their use. In the pleaded defences to the action there was a denial of infringement, and an allegation of invalidity of the patent.

Mr. Astbury: The substantial defence is as to the invalidity of the patent.

Mr. Moulton said that that was substantially the great question. The objections to the plaintiffs' patent were, he believed, as wide as usual, but the defendants did not allege disconformity.

His Lordship: That is a comfort.

Mr. Moulton, continuing, said the defendants further alleged that the plaintiff's invention was not new, and that it formed the subject matter of a prior grant which was in the Patent Office, but not published. There had never been a decision on this point, but those who were responsible for the defence said it was a good one. The third paragraph of the defence raised the question in another form, and said that the man who applies for, but whose patent is not published, is the true inventor. The defendants further said it was not subject matter for letters patent.

His Lordship: Is that under a separate head or merely formal?

Mr. Astbury: We say there was no subject matter in this invention. It is important therefore.

Mr. Moulton, continuing, said that the subject of Handford's invention was the mounting of electric motors on electric cars. Of course, electric cars were driven either by a current which came from batteries situated on the car or by currents communicated from fixed conductors to the cars. The current had to pass round the dynamo in the car, and then it was made to revolve at a great number of revolutions per minute, and the power had to be communicated to the wheels, which was the driving power, and the consequence was that it had to be communicated by gearing straps, or something of that kind, so as to drive round the axle of the wheel. A dynamo was always very massive, heavy, and bulky, and it had to revolve with great accuracy. In the first place, it was necessary to have the dynamo, which acted as a motor, so mounted that disturbance did not throw it out of gear. The method of fixing the dynamo to the car invented by Mr. Handford had, he believed, been universally adopted in electric traction for getting over the difficulties he had mentioned. The dynamo, which acted as a motor, was so mounted that the disturbance did not throw it out of gear, and that shocks produced as little effect on it as possible. Mr. Handford fixed his motor by having it sleeved on the driving shaft, and its armature worked on a parallel shaft. If a jolt came to the driving wheel it did not give a jolt to the whole motor, which relieved itself by a slight rotation. If the motor was balanced on the axle a blow would be communicated to the whole motor. The rotation of the motor caused by a jolt was partly checked by means of springs which held the motor at one end, and another function of the springs was to prevent the serious jolt of the car. His learned friends said that that was not subject matter for letters patent. Well, if that was not subject matter for letters patent, what was? The learned counsel then referred in great detail to the plaintiff's complete specification in which the claim for the invention was as follows:—"The motor of an electric railway car or carriage having its field magnet centred or sleeved upon a driving axle, its armature supported directly upon the said field magnet, and having a shaft separate from the driving axle and gearing communicating motion from the armature shaft to the driving axle. (2) The motor of an electric railway car or carriage, partly or wholly separated by springs from the car body, carriage body or truck, and having its field magnet centred or sleeved upon a driving axle, its armature supported directly upon the said field magnet, and having a shaft separate from the driving axle and gearing communicating motion from the armature shaft to the driving axle. (3) The motor of an electric railway car or carriage centred upon the driving axle at one end, and having spring supports at the other end." The learned counsel said that the utility of the invention could not be denied, and he did not think it could be denied that there had been infringement.

Mr. Dugald Clark, examined by Mr. Bousfield, said he had examined and made himself acquainted with the plaintiff's specifications and the alleged anticipations. He had also been shown drawings of the alleged infringements. As he understood the specification, the inventor dealt with two things: Firstly, to so arrange his electric motor that it should remain in gear with the driving wheel. He also desired to so arrange his motor that it was not exposed to rude shocks. Those objects were accomplished by the invention.

In cross-examination by Mr. Cripps, Mr. Dugald Clark stated that the object sought to be attained in the attachment would not be the same whether the motor was electric or steam. In the steam motor the problem was a very different one, and the connection of the motor to the axle, to be worked successfully, required very different conditions altogether; it was necessary that the driving-wheel should remain in gear and the motor should not be exposed to road shocks, and it was necessary in every case to suspend the motor so that it should remain in gear. In steam power that was dealt with at a very early date, but the first attempts were failures. Roughly speaking, the same objects had to be attained with either steam or electric power; but the great liability was as to shock, and so far as that was concerned, most of the locomotives were not free from shock. Undoubtedly an object was to reduce shocks. He (Mr. Clark) did not know that the supporting spring was an essential method of the plaintiff's arrangement, but some method of spring was essential. The object of the spring between the field magnet and the body of the car was to suspend the end of the motor in such a way that the truck could move without moving the motor appreciably. His own opinion was, that this was one of the essential features of the plaintiff's invention. He called them springs of suspension. It was a novelty at the time to have a motor centred or sleeved upon the driving axle. He believed it was not novel to have an armature supported on a field magnet. In an electric motor, he believed it was novel to have a shaft supported from the driving axle; he could not call to mind any electric motors that had had it. In steam motors there was such a thing. There must always be the gearing communicating motion from the armature to the driving wheel. Except as regards the spring, they had had all the other elements of plaintiff's claim—but not in combination with a motor, and the relieving of the axle of dead weight indicated what the inventor was trying to do, that was, the avoiding of shock, which was shown by the springs, and making the motor one-sided. He (Mr. Clark) had seen an extract from the Official Gazette of the United States of America Patent Office, dated June 30th, 1885, and it showed the plan of what was now being claimed, but he found no description, and without that it would be unintelligible. Knowing it now, he could recognise it, but as the plan stood it would leave the whole thing for invention, because, although shown sleeved at one end of the driving axle, and with the other end attached in some way to the frame, there was nothing to show that there was not a rigid frame; and in that case there was no invention whatever. There was no sign of elastic attachment, which he (witness) took to be the whole essence of the invention. There must be an elastic attachment of some kind, equivalent to a spring.

Witness, in answer to questions with reference to Reckenzaun's electric motor, said it was not centred on the driving axle. It was bolted to the frame, and the invention which it was the object of the plaintiff to make, was not present. There was no centring in the sense of the word as used in plaintiffs' specification. Eliminating the spring element, they had in Reckenzaun's a frame which wasn't sleeved to the axle, but the same as if they had the truck made without springs and the motor fixed to the frame. So far as the field magnet was concerned, it was all one rigid mass. Directed next to Finney's electrical invention, Mr. Clark said the frame of that motor was attached to the driving axle; it was not sleeved on the axle in the sense in which the word sleeved was used; there must be some elasticity of movement, otherwise there was no sense in the word, and, therefore, in the plaintiff's case it must imply springs or spring connection. The point of plaintiff's invention was suspension of the motor, and that must be by spring connection or its equivalent. Mr. Clark, in reply to further questions, said that in Adams's invention the action was altogether different; and it showed he had no idea of avoiding shock, the armature being in the very position where it would receive the worst usage. Adams missed the object of plaintiff's invention by his concentric and equal arrangement. The same spring attachment was found as in plaintiff's, but there was nothing in that, because it must be attached in a certain way to do certain things. One of the objects—he would not say the main object—of plaintiff's invention was to attach the field magnet in such a way that it would always occupy the same relative position to the wheels and armature, and not be disturbed by the spring connection between the body of the car and the wheel, and to do that in such a way as to avoid shock. Adams's invention had actually been used in the United States, but it was not successful in avoiding shock. It was quite obvious it would not do so.

Mr. Clark was also cross-examined by Mr. Cripps with reference to the Jensen (Edison) invention, and Hermann's, Benn's, Pyott's, Garland's, Longstaff and Pullen's and Cryders. In the case of

Hermann's steam road wagon, the motor for the driving power was sleeved or centred on the driving axle, along with the boiler and all the other parts, and the arrangement was such that working on a rough road, all the teeth of the gear wheels would be broken off. He quite admitted that the theory in this case was the same as plaintiff's, but it was applied in an utterly impossible way. The specifications to which his attention had just been called came the nearest to plaintiff's, so far as the other elements of the invention outside the spring connection was concerned. In that of Longstaff and Pullen, all the weight was concentrated over the driving wheel, and although there was a spring at one end, it would not produce the effect produced by plaintiff's spring, for the same reason as Adams's arrangement did not.

The hearing was then adjourned until next day.

On Wednesday, 8th inst, the hearing was resumed.

Mr. Dugald Clark, re-examined by Mr. Fletcher Moulton, gave it as his opinion that the plaintiff's invention was a practical one for overcoming defects in mounting electric motors. The problem of getting over practical defects for mounting steam motors was not the same as for electric motors—it was quite different. A steam motor was one in which all parts remained in the same position relatively to one another. With regard to electric motors, there was rotation round axles. It did not follow that a successful method of supporting steam motors would be successful with electric motors. He had had several specifications with reference to steam motors put to him, and to the best of witness's knowledge they had all been failures.

They do not show the systems which have been adopted for suspending steam motors?—Not one of them.

To the best of your belief, did anyone of these specifications become common knowledge, or come into common use?—No; not one of these came into common use.

Are they quite different from the plaintiff's specification?—Yes, quite.

Re-examination continued: Hermann's was not a practicable thing at all?—Quite impracticable.

The Witness was then referred to Bean's specification, where he said the motor was not supported in the same way as the plaintiff's invention.—In Bean's arrangement the motor boiler and truck all shared the same oscillations, and the consequence of that was that he could only drive chain gearing. He could not run the thing with tooth gearing.

In Pyott's there was a rigid truck. The essence of his invention was to make a truck with adjustable wheels. The object of his construction altogether was to allow a rigid bogey to run round a curve, and the engine in this case was attached to a rigid bogey. That was not the plaintiff's invention. There was no possibility in Pyott's of saving shocks or anything of the kind. The problem with which Pyott was dealing was not a mechanical problem with regard to shock. Longstaffe's was a very complicated method of supporting, and in the opinion of witness not at all a practicable one. In the first place, the weight of the motor was not supported in the same way as it was in the plaintiff's invention. In Longstaffe's the motor was right on the top of the driving wheel, and was rigidly connected with the driving wheel, where it would receive all the shocks.

Is it in that respect Adams's?—Yes; in that respect it is like Adams.

Re-examination continued: In his opinion, Cryders' invention was not practicable for many reasons. All the suspension systems presented great difficulties in getting steam supplied for the cylinder.

Mr. Jas. Swinburne, examined by Mr. Moulton, said he had studied carefully the plaintiff's specification. In his opinion it clearly described the invention which the previous witness had referred to in his evidence. The invention was a useful one. He had given a considerable amount of attention to electricity and electric motors. In his opinion the plaintiff's invention proved of exceptional utility in connection with electric traction. It was enormously used. The problem solved by Handford was so arranging a motor that it got a minimum of shock and a minimum of communicated motion, and that was most desirable for the motors in use in the year 1885. The invention of Handford consisted of a combination, and although sleeving a body on an axle was known, and springs were also known at the date of the patent, the combination was new. There was nothing in the drawings which had been put in to teach him the plaintiff's invention. They did not show the essential mechanism of the plaintiff's invention. There was nothing in those drawings which showed the spring support. He did not think that the public could have learned the plaintiff's invention from those drawings. In Reckenzaun's the motor was not in any sense sleeved on the driving axle. In Finney's the motor was rigidly fixed to the frame. There did not appear to be any springs in the whole affair. It could not be said that that was the plaintiff's method of suspension at all. That was exactly what it was not. In Adams's the motor was put right on the top of the axle, on the centre of the axle, so that all the shocks were communicated to every part of the motor. In witness's opinion there could not possibly be a worse method of support. The springs there used were not in any sense the springs used by Handford.

Cross-examined by Mr. Cripps, the witness said that springs would be practically essential for electric motors on tramcars. The spring, which was the essence of the plaintiff's specification, was not indicated in Reckenzaun's.

Re-examined by Mr. Bousfield, the witness repeated that the features of the plaintiff's invention were sleeving on the driving axle and spring suspension from the moving car. In the other cases which had been put to him, the problem which plaintiff dealt with was not dealt with.

Lord Kelvin was next called, and examined by Mr. Bousfield. You have, I think, given a good many years of your life to electrical problems of one sort or another; let me ask you first of all, suppose in 1885, the date of this specification, you had your mind directed to the question of how best to attach a motor to a thing like a tramcar with a body connected by springs to the wheels, was there anything in common knowledge at that time, with reference to steam engines and other kinds of motors, which would have helped you to a solution of the difficulties of that problem?—No, there was not.

Then, taking these specifications—which I do not think it is suggested were part of common knowledge—taking the specifications with reference to these devices relating to steam engines, do you think they would have helped you to a solution of this problem as to how to attach an electric motor most advantageously to a thing like a tramcar with a body supported by springs on wheels?—No, I don't think so.

Counsel was proceeding to question Lord Kelvin with reference to the Jensen (Edison) invention, when

Mr. Cripps asked if it were worth while?

Mr. Bousfield said that in that case he would go on to Adams.

His Lordship: The witness has said, subject to cross-examination, that there was previous to that time nothing in common knowledge; I think you had better leave it there.

Mr. Bousfield, to witness: Given that thing to be solved, what do you say, taking one of two or three illustrations, of Finney's method?

Mr. Cripps said they had the actual specifications.

Mr. Bousfield said he wanted to take the matter shortly, and to classify the different specifications which had been suggested as anticipations.

Mr. Cripps objected to the form of the question, which was not pressed.

Mr. Bousfield: Lord Kelvin, is a method in which a motor is rigidly fixed on to a framework, rigidly attached to the axle with the wheels, in your view the same as plaintiff's?

Mr. Cripps: We are all agreed it is not. I certainly have not suggested it.

Mr. Bousfield: Can you point out, Lord Kelvin, any difference between Finney's method and a method such as I have described?—In Finney's method there are no springs.

Take the case of a pair of axles with bearings, carrying a rigid framework and a motor rigidly carried on that framework, that you say does not suggest the plaintiff's?—No.

Can you distinguish Finney from a thing of that sort that I have just put to you?—Perhaps you will tell us in your own way in reference to Finney.

His Lordship: Lord Kelvin, in your view, what is the difference between Finney's and the plaintiff's?—That there are no springs.

Mr. Bousfield: Can you see any one of these specifications which is like the plaintiff's?—No.

Cross-examined by Mr. Cripps: I understand the point of difference you refer to is, that you don't find the springs in these other cases which have been put to you?—That is one essential difference.

And you look on the the spring as an essential feature of the plaintiff's invention?—Yes. Without springs, it would be the play of Hamlet with the part of Hamlet left out.

Mr. John Alex. Henry Blackburn, manager of the plaintiff company, was next called as a witness. He said he had had a very large experience in the working of electric motor traction, and for the last four or five years had been more or less engaged in investigation as to the different types of motors which had been in use from time to time.

Mr. Cripps did not see what that went to show in this case, and the witness left the box.

Mr. Bousfield then addressed his Lordship. He said he thought the problem before this inventor was a fairly clear one; he came in at a time when it was thought that electricity could be usefully applied to tramcars, and the problem was, how to avoid shock? Plaintiff's method had been the only successful one, and it had been universally adopted.

Mr. Cripps opened the case for the defence. His first point was, the matter was one of pure construction, and nothing else, and that question was whether, in claim 1, the inventor had not disclaimed—to use a common expression—the spring element in the invention. He argued, on the evidence so far before the Court, that the spring element was an essential element of plaintiff's invention, because in the body of the patent one saw constant reference to the word spring, but when they came to the end, there were found three claims, all based on the spring element, and in claim 1 not so, yet the Court was asked to read the spring element into claim 1, from which he (counsel) contended it was specifically eliminated. Mr. Cripps, apart from the question of construction, contended that the four elements, other than the spring element, which plaintiff claimed had been anticipated in specifications to which the attention of the Court had been called, and he further argued that in certain other specifications there was the equivalent of plaintiff's spring attachment.

The further hearing was adjourned.

Tevenan v. Vanderburg.

In the Queen's Bench Division, Dublin, on Saturday, before Mr. Justice Boyd, the case of P. J. Tevenan *v.* J. Vanderburg came on for hearing. It was an application on behalf of the plaintiff for an order that he be at liberty to issue a writ for service out of the jurisdiction. Mr. John Bartley said that the plaintiff, who resided in Dublin, was employed by a Mr. Sax, who resided at East Molesey, Surrey, to do clerical and agency work with him for the intended defendant, who resided at 55, Thistle Road, Newington, London, and had his place of business at 21, Mincing Lane, London. Mr. Sax came

to Ireland as agent for Mr. Vanderburg, his father-in-law, in order to work up contracts and business in connection with lighting by electricity in Dublin and in Ireland generally. He employed the plaintiff at a salary of £6 per week, of which £93 6s. 9d. was still due and unpaid. Sax also agreed that the defendant would pay him for board and lodging £3 per week, and on foot of this £20 7s. was still due. The contract was made in Ireland, and the work was all done here, where the action could be most conveniently and cheaply tried. The total sum due was £113 16s. 3d.

Mr. Justice Boyd made the order sought.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Nov. 8th, 1898.		Week ending Nov. 7th, 1899.	
Adelaide	Value £1,148	Adelaide	Value £180
Bombay	54	Alexandria	106
Boulogne	17	„ Teleg. wire. ..	89
Brisbane	414	Amsterdam	88
Calcutta	50	Antwerp	90
Cape Town	60	Beira	75
Colombo	225	Bombay	36
Durban	775	Boulogne	40
East London	351	Brisbane. Teleph. cable ..	890
Gothenburg. Teleg. mat. ..	22	Buenos Ayres	2,326
Hamburg	120	„ Teleg. mat. ..	925
Launceston..	90	Calcutta	86
Madras	76	„ Teleg. wire	104
Malta	2 6	Cape Town	377
Melbourne. Teleg. mat. ..	491	Channel Islands. Teleg. poles	120
Montreal	123	Colombo. Teleg. mat.	10
Ostend	64	Copenhagen. Teleg. wire ..	23
Rosario	239	Demerara. Teleg. cable ..	448
Rio de Janeiro	65	„ Teleg. mat. ..	57
St. Petersburg	20	Durban	141
Shanghai	156	„ Teleg. mat.	3,166
Stockholm	470	„ Teleph. mat.	160
Sirlina. Electric detonators ..	63	East London	257
Sydney	655	Gothenburg..	116
Wellington	942	Hamburg	121
Yokohama	2,216	„ Teleg. mat. ..	435
		Hobart. Teleg. wire	19
		Hong Kong	40
		„ Teleg. mat. ..	24
		Jamaica. Teleg. mat.	14
		Madras	244
		Mauritius. Teleg. stores ..	35
		Melbourne	188
		Ostend	80
		Port Elizabeth	40
		Rangoon. Elec. mining machy.	1,000
		Rotterdam	175
		Shanghai	994
		Singapore	87
		Stockholm. Teleg. mat. ..	167
		Sydney	1,891
		„ Teleg. mat.	76
		Tokio. Teleph. cable	1,278
		Valparaiso. Teleg. mat. ..	144
		Wellington	119
Total ..	£9,009	Total ..	£15,974

Foreign Goods Transhipped.

Brisbane. Teleph. appar.	Value	£65
Piraeus. Electrical goods	..	28
Total	..	£93

Allen & Co. v. Universal Process Company.—In the Westminster County Court on Thursday, November 2nd, Messrs. Allen & Co., electrical engineers, sued the Universal Process Company for work done for the defendants. It seemed that the defendants' arc lamps wore out very rapidly, and the plaintiffs arranged to keep them in repair for £10 a year, payable quarterly. This was exclusive of 30s. for putting them in repair at the start, and carbons. During the first quarter defendants telephoned to them to send round and see to the lamps whenever required, and attention was then given. For some time telephone messages were received during the second quarter, but afterwards no communications were received, and when asked for payment they said plaintiffs ought to have sent fortnightly to do the work. Plaintiffs' answer to that was, that having put in special carbons the necessity for repair did not so often occur. The defence was that the plaintiffs should have sent periodically but they did not.—His Honour said the practice seemed to have been for the plaintiffs to have been sent for, and thought the contract might have been ended at any time but it had not been.—Judgment for the plaintiffs for the amount claimed, with costs.

Bankruptcy Proceedings.—On 3rd inst. S. F. Walker, electrical engineer, Cardiff, was again examined at the Cardiff Bankruptcy Court. Mr. Belcher, who appeared for the trustee, complained that debtor had not complied with the order made upon him at the last Court to supply details showing how he made up the totals in his deficiency account. Mr. Gilling, for the debtor, pleaded that the bankrupt had misunderstood the order. Debtor was further examined by Mr. Belcher with reference to his furniture at Severn Road and Bath, which was claimed by his wife. Debtor said all the furniture was bought by his wife with money supplied to her by her mother. He was prepared to supply an inventory of the furniture. He denied that he had a valuable scientific library. The books consisted mainly of the records of a number of societies to which he belonged. The examination was adjourned, debtor to supply the required accounts by December 1st.

At a sitting of the London Bankruptcy Court, held on the 3rd inst., before Mr. Registrar Brougham, Archibald Edward McKechnie, described as of Newton Road, Bayswater, applied to pass his public examination upon accounts showing liabilities £908 and assets 6s. In the course of his evidence the debtor said that for some years after 1880 he was in America, and was assisting in the promotion of various electrical companies and the development of electrical patents. He made £10,000 out of those patents, but sunk £7,000 in an unfortunate railway investment, and had spent the remainder. Witness came to England in July, 1896, with £2,000. Since his residence in this country he had lost £370 in connection with a scheme to form a company to put a new cycle lamp on the market, and now his money having all run out, he was dependent upon loans from relatives. The examination was ordered to be concluded.

Catalogues, &c.—Messrs. Green & Boulding, of Bunhill Row, E.C., send us an illustrated pamphlet (dated October, 1899), descriptive of the Buffalo automatic injector which they claim to embody all the essential points of an efficient and economical boiler feeder. The same list describes the Tripp metallic packings.

The Unbreakable Pulley and Millgearing Company have sent us a circular of their wrought-iron split pulleys and adjustable swivel bearings, and a reproduction from a photograph of friction clutch countershafts in swivel bearings made by them for a firm of Manchester engineers.

Messrs. C. Nurse & Co., of Walworth Road, S.E., have issued an illustrated price list (312 pp.) of engineers' and joiners' tools and machinery of all kinds. The book is very fully illustrated with cuts of a large variety of tools and other articles.

Copper.—We gather from a daily paper that Messrs. James Lewis & Son's monthly report on copper, dated November 1st, contains the following:—

Confidence in the ability of the Amalgamated Copper Company to maintain values at their present level has been somewhat severely shaken by the weakness of the American market and the pressure to sell American electrolytic copper to European consumers at lower prices, the fall in the quotation for Lake copper to 17½ cents on the 20th ult. inducing a raid on the market by dealers and speculators, which brought about a fall from £75 16s. 3d. on the 17th to £72 17s. 6d. on the 24th. With some of the leading sellers buying back at the decline, and American support, a reaction to £74 8s. 9d. followed, but values subsequently fell away again to £72 10s. on the 31st. Closing values are £73 5s. for cash and £72 10s. for three months' prompt—a fall since the 2nd ult. of £2 16s. 3d. and £3 7s. 6d. respectively. The detrimental effect of the large shipments of Chili copper out of stock here to Baltimore and New York for conversion into electrolytic copper—5,170 tons to date—is now apparent in the large quantity of the latter quality offered for sale, competing with English best selected ingots, which were becoming very scarce and for which a premium of £7 per ton over standard had been paid. For best selected ingots there is a good demand, with buyers at £80—Birmingham terms—for November, and sellers at the same for December and January delivery. Lake copper in New York has fallen to 17 cents per pound, at which a large sale has been made by the Calumet and Hecla Company to American consumers. This represents a fall of £6 18s. in the course of the month. Electrolytic has been largely sold for export to the Continent at low prices and still presses for sale, English consumers showing little inclination to buy except for their immediate wants. The shares of the Amalgamated Company have sold down to 86 dollars. As a result of the control by this company of the Anaconda Copper Company, it is stated that the latter will not issue any report of its operations for the year ending June 30th last—holders of the shares in this country being kept in ignorance of the company's position.

The Copper Market in October.—Messrs. H. R. Merton and Co.'s circular of November 1st shows that during October stocks have declined by 1,524 tons, and that the price of standard copper has likewise fallen—£2 17s. 6d. per ton. The stocks on September 30th totalled 28,328 tons, and on October 31st 26,804 tons. The supplies in October amounted to 19,799 tons, but of this total no less than 2,994 tons found its way to America, so that the supplies for consumers in this country only reached a total of 16,805 tons. As the deliveries on this side totalled 18,329 tons, the fall in stocks was 1,524 tons. It is remarkable that the shipments to America were higher than any yet recorded in one month, since this noteworthy feature of the present position of the copper market came into existence. Messrs. H. R. Merton & Co. now devote a special column of their return to "Shipments of 'Standard' to America," and from this we take the following figures:—

June	1,875	tons.
July	500	„
August...	—	„
September	2,276	„
October	2,994	„
Total ...	7,645	tons.

It would be remarkable if the country which produces more than one-half of the copper supply of the world were unable to increase the output of its mines sufficiently to supply the home demand—and most people see in these purchases of copper on American account on this side of the Atlantic, merely attempts to rig the market in favour of the New York syndicate. The success in this direction has not been very striking, for in spite of the 7,645 tons shipped from this country to New York, or other American ports, the price of G.M.B.'s has fallen from £76 15s. on May 31st to £72 17s. 6d. on October 31st, the fall having occurred chiefly during the last two months. We hope that this downward tendency in the price will continue until copper has again reached its normal level of value. The supplies of copper in October amounted to 19,799 tons, and were made up as follows:—

From North America ...	8,135	tons	
„ Spain and Portugal ...	2,548	„	
„ Chili	2,550	„	(to Europe and U.S.)
„ Australia	1,800	„	
„ other countries... ...	4,766	„	

All of these, with the exception of the shipments from North America, were above the average for the preceding 12 months,

the deliveries from the outside countries being just double those recorded for October 1898. No new copper mining companies have been floated during the past month in this country, but in America the Stoddart Copper Company has been formed to purchase and work properties situated in Arizona. The military operations at the Cape and in Natal will hinder copper mining and development work in that quarter of the world, and the activity spoken of by Lord Loch at the annual meeting of the Standard Bank of South Africa, is likely for the present to be entirely suspended.

Correction.—In last week's article on "Electro-Pneumatic Signalling," we state on page 704 that the works of Messrs. McKenzie & Holland are at "Gloucester." This should have been *Worcester*.

Enclosed Rheostats.—The Ward Leonard Company, of America, has just taken out a new patent (October 24th, 1899), for an enclosed type of rheostat. This form has, we understand, become the favourite type for motor starters during the past few years. In the most approved form the resistance material is in the form of a reflexed ribbon which is embedded in sand, which sand is the filling material of a shallow box made entirely of iron or having one face of slate. The patent above referred to thoroughly covers the essential features of this form of rheostat box. A typical claim in the patent is as follows:—

Claim 23.—"In a resistance box, the combination of a box having two large parallel surfaces and a relatively narrow edge, one of the large surfaces being in the form of a cover, a resistance within the box arranged in steps or sections, terminals to which said steps or sections are connected, and a removable filling of mineral insulating material surrounding said resistance."

For Sale.—In our advertisement pages will be found particulars of a sale of machinery, plant, and stock-in-trade of Messrs. S. F. Walker & Co. (in bankruptcy), at Cardiff, on 14th inst.; also of a sale to take place at Globe Works, Leeds, on November 21st.

Furious Driving.—Before Mr. Curtis Bennett on Tuesday, Henry Leitner, of 207, Piccadilly, was convicted of furiously driving an electric motor-car at Regent's Park, the alleged rate being 19 miles an hour. Mr. Leitner had been cautioned a few days before, and he promised not to offend again. Mr. Curtis Bennett fined him 20s. with 2s. costs.

Good Dividend.—The Allgemeine Electricitäts Gesellschaft, of Berlin, is declaring a dividend of 15 per cent. for the past financial year.

Hart Accumulators.—The Edison & Swan Company have just concluded an arrangement with the Hart Accumulator Company, whereby they are granted the sole agency for this firm's accumulators and manufactures in Glasgow and Dublin. Any inquiries for the Hart cells from these centres, the Edison & Swan Company ask, should be sent to their Glasgow and Dublin branches, 153, West George Street, Glasgow, and 12, Dawson Street, Dublin.

Liquidations, Dissolutions, &c.—A petition presented by a creditor (George Trenam, 7, New Court, Lincoln's Inn), for the winding up of the Milver Portable Electric Battery Syndicate, was before Mr. Justice Wright on 1st inst., and was adjourned to November 15th.

A meeting of the Shropshire Electric Light and Power Company will be held on December 4th at 9, The Square, Shrewsbury, to hear an account of the winding up from Mr. W. W. Naunton, liquidator.

The London and Lancashire Electric and General Engineering Company, will meet at Broad Street Avenue, E.C., on December 4th, for a similar purpose. Liquidator, Mr. F. A. Franklyn.

The *London Gazette* contains notice of the release of liquidator (Mr. Samuel Wheeler) in the case of the Collier Audible Telephone Company, Limited, of 5A, Coleman Street, E.C.

Creditors of the Thames Ironworks and Shipbuilding Company (old company), must send particulars of debts, &c., to the liquidator, Mr. H. P. Hussey (Orchard Yard, Blackwall) by December 16th.

Messrs. J. Pearson, G. Normanton, N. Brooke, W. Emmott and others, trading as the Electrical Development and Light Regulating Syndicate, have dissolved partnership. W. Emmott and F. Whiteley will continue the business under the old style. Debts, &c., to be received and paid by Mr. G. M. Riley, solicitor, Post Office Chambers, Halifax.

Single-phase Motors.—With reference to an article on the Heyland single-phase motors that recently appeared in our columns, Mr. A. C. Eborall has asked us to state that the starting resistance for these motors can be of any usual pattern, as no special construction is needed. The particular resistance illustrated is a standard construction of the Helios Company, of Köln-Ehrenfeld.

Trade Announcements.—Messrs. Nisbett & Sutherland have taken into partnership Mr. E. Marcuson, and will henceforth trade under the style of Nisbett, Sutherland & Marcuson, at the old address, 61, Chandos Street, Strand, London. The firm make a speciality of storage batteries of exceptionally light weight.

Messrs. Hiscock & Middleton, electrical engineers, of 164, Forest Lane, Forest Gate, E., have given up their premises at East Street, Barking.

Wheeler Condensing Plant.—The National Supply Company, of Preston, have decided to adopt the Barnard-Wheeler cooling towers for the extension of the condensing plant at their station at Preston. It will consist of the above-mentioned cooling towers with fans for forced draught, capable of cooling the circulating water for the Willans engine of 1,500 H.P., a Wheeler surface condenser, and a set of electrically operated air and circulating pumps. The above firm is exceedingly busy at the present time with the installation of cooling towers, having just finished the erection of one of 7,000 H.P. for the Central London Railway at their Shepherd's Bush station, and a tower for the Metropolitan Electric Supply station at Willesden of 8,500 H.P. capacity, in this latter case a complete equipment of their vertical air and circulating pumps have been included. At the Brighton electrical station a cooling tower has been erected on the roof, of 2,500 H.P., being an extension of the existing tower, which is of equal capacity. At the Belfast Corporation electricity works a tower of 2,500 H.P. is in process of erection, and at the Croydon station a tower of 800 H.P. has been erected over a part of the existing cooling pond. The Wheeler Condenser and Engineering Company have also in hand at the present time towers for the London United Tramways, at their new power station at Chiswick, of 3,500 H.P.; for the Sunderland electricity works, of 3,000 H.P. capacity; and for the Isle of Thanet light railways, of 2,500 H.P., besides a number of other towers of smaller capacity, and in each case the above firm are supplying their well known surface condensing sets in conjunction with the towers.

ELECTRIC LIGHTING NOTES.

Austria.—A Dresden firm is establishing a central station in the town of Ybbsitz (Lower Austria). The water-power of the Notbach is being applied, the plant comprising two turbines and three dynamos.

Bala.—The District Council has adopted the resolution which was passed by a ratepayers' meeting there lately, and has appointed Mr. Peers, consulting electrical engineer, of Manchester, to make a report on the subject.

Barmouth.—The District Council has decided to apply for a provisional order for electricity supply, and has appointed Mr. F. J. Warden-Stevens consulting engineer, to report on a suitable scheme.

Barnard Castle.—The District Council on Saturday last agreed to support the application of the Northern Counties Electricity Supply Company for a provisional order empowering them to provide an installation at Barnard Castle, subject to the Council retaining the right to have included in the order such reasonable clauses as they may deem necessary in the public interest.

Battersea.—The Vestry, on Wednesday, decided to enlarge the scope of the electric lighting scheme to the extent of increasing the expenditure by £5,381 for mains and lands. It was also resolved to issue advertisements inviting tenders for the supply of arc lamps and lamp columns.

Berwick-on-Tweed.—The Corporation is considering the question of electric lighting, and Mr. A. A. Campbell Swinton has been retained to advise it.

Birmingham.—The electricity supply failed, for the first time, for about 1½ hours on Monday last, and in some parts of the city it was cut off all night. The difficulty was said to be due to the blowing of a main fuse in the electricity works.

Blackpool.—The electrical engineer has reported to the Lighting and Tramways Committee in favour of extensions of the electricity works, at an estimated cost of £42,515. The scheme includes plant for both lighting and traction, as well as a storage battery for use in connection with the latter. Mr. Quin looks upon economisers as a convenient means of overcoming faulty design; he therefore intends to dispense with them, and to instal quick-steaming boilers having sufficient heating surface in themselves. A 1,200-KW. steam alternator is recommended as a suitable unit for the present and future extensions; as the maximum lighting load is at present 1,200 KW., a large increase is evidently looked for. Two 300-KW. sets are included for traction, and a 400-ampere battery. Ten 50-KW. transformers, and three new sub-stations are to be installed. The Committee has approved of the report, which will be laid before the Council very shortly.

Bolton.—Col. J. T. Marsh, R.E., Local Government Board Inspector, held an inquiry on Tuesday last with respect to an application by the Corporation for leave to borrow £100,000 for electric lighting purposes. Supply was begun in 1894, since when £68,222 has been expended. The present loan is for extensions, as follows:—Buildings, £11,911; condensing plant and cooling tower, £6,811; boilers, pipes, engines and generators of 2,400 KW. output, £47,524; mains, £23,536; transformers, £7,325; meters, £5,634. The plant at present installed is of 3,000 H.P.; there are 43,740 lamps connected, and the output in 1898-9 was 416,635 B.T.U., yielding a net profit of over £1,200. There was no opposition.

Bombay.—The applications for permission to establish stations and lay down cables, &c., for the supply of electric light and power in the city of Bombay have been referred to a Committee of the Corporation for consideration. *Indian Engineering* says that the sense of the Commissioners was that it was essential in the interests of the public that they ought not to create a monopoly by accepting the application of one party only.

Brookwood Asylum.—Application has been made by the Surrey County Council for a loan of £71,270 for the purpose of enlarging the Asylum at Brookwood, which is now filled to overflowing with pauper lunatics. The plans as laid before the Public

Works Loan Commissioners include an installation of electric light at a cost of £5,700, three new engines being required of 100, 60, and 30 H.P. respectively, to supply current for 900 16-C.P. lamps.

Brierley Hill.—The *London Gazette* for 7th inst. contains notice of the application of the Urban District Council for a provisional order.

Calcutta.—Proposals are on foot for putting electric light and rotary fans in St. Paul's Cathedral, Calcutta. An Indian exchange says that the fans will be especially welcome, since the present punkahs render the preacher invisible at every stroke! A trial is now being arranged.

Charlcombe.—The Parish Council is desirous of obtaining an electricity supply from the Bath Corporation Works.

Chertsey.—The District Council has consented to allow the Woking Electric Supply Company to obtain a provisional order for lighting the western boundary of the district, without opposition, and has under consideration a similar application, covering the whole district, from the Electric Power Distribution Company.

Cork.—After some vacillation and misunderstanding, the Corporation has finally accepted the recommendation of the Public Works Committee that 600-watt arc lamps be adopted for the lighting of the town, to burn all night.

Dundee.—Reporting recently to a meetir of the Tramway Committee, the city electrical engineer intimated that in consequence of the backward state of the new buildings and the non-delivery of new plant, the existing plant would be insufficient to cope with the coming winter demand, and suggested that no further consumers should be added to the list. The committee resolved to give public notice that the department would be unable to receive applications for the supply of electrical energy until further notice.

The first annual supper of the employés of the electricity station was held on the 1st inst. at the Royal British Hotel. Ex-Provost Brownlee presided, and he was supported by Mr. W. H. Tittensor, chief engineer, and his assistants.

Durham.—At a meeting of the Town Council last week the Electric Lighting Committee presented a report stating that of four offers received for taking over the provisional order for electric lighting in Durham, they considered none so favourable as that of the County of Durham Electrical Power Distribution Company. This company offered to supply electricity for public lighting at 2½d. per unit, and for private lighting at 7d. per unit for the first 100 units and 2½d. beyond this quantity. The company undertook, in conjunction with the British Electric Traction Company, to promote a light electric railway from North Road, Durham, *viâ* Neville's Cross, to Brandon. It was decided that the Council transfer its powers under the Electric Lighting Acts to the County of Durham Electrical Power Distribution Company upon the terms mentioned in their offer.

Ealing.—The accounts of the Electricity Department for the year ending March 31st last show a net profit, after paying all charges, of over £65. The total capital expenditure amounts to £77,177 9s., half of which was devoted to the mains. The gross revenue was £8,771 18s. 5d., and the gross profit £3,624 6s. 9d. During the year over half a million units were generated. It is hoped that a large profit will be realised next year.

Erdington.—The District Council has resolved that application be made to the Board of Trade for a provisional order under the Electric Lighting Acts to supply electricity for public and private purposes within the district of Erdington.

Germany.—The Westfalischen Electricitäts Gesellschaft, of Dortmund, has secured a contract to establish a large electric power station at Berringhof (Ruhr). The plant will comprise three large turbines and dynamos and a battery of accumulators, and will supply electrical energy for lighting and power purposes at Menden, Frondenberg, and Wickede.

Gloucester.—The City Council has decided to borrow £10,000 from the Capital and Counties Bank on account of the amount required for electricity works.

Great Yarmouth.—Mr. G. W. Willcocks, M.I.C.E., held a public inquiry on behalf of the Board of Trade on Friday last relative to an application by the Corporation for sanction to a further loan of £27,000 for the extension of their electricity supply undertaking. The outlay is required for additional plant to meet the increasing demands of private consumers, to extend the electric light across the harbour to Gorleston and Southtown, and to supply motive power to the tramways, which the Corporation are about to construct. The surveyor stated that the municipal electric light works in Yarmouth were started in 1894 with 700 8-C.P. lamps for customers, and some arc lamps for street lighting. This year the number of 8-C.P. lamps had increased to 18,900, and the arc lamps for street lighting to 62. The financial position of the undertaking had steadily improved, and in the quarter ending September 30th, one of the worst in the year, £77 was earned over and above all charges. He estimated the clear profit for the year would not be less than £500. Mr. R. Martins, chairman of the Electric Lighting Committee, also gave evidence in support of the application.

Halifax.—At about 7 p.m. on Monday last, according to the *Bradford Observer*, the electricity supply suddenly ceased, extinguishing the public and private lighting, and bringing the tramcars to a standstill. Supply was renewed after about an hour's stoppage. The fault was said to be in connection with one of the generators.

Hanley.—Major-General Crozier, R.E., inspector of the Local Government Board, held a public inquiry on Tuesday with respect to an application by the Town Council for sanction to a loan of £5,000 for electric mains, transformers, meters, &c. There was no opposition.

Hartlepool.—The Hartlepools Electric Tramways Company, Limited, is desirous of negotiating with the Town Council for the acquisition of the electric lighting order which the Corporation has recently obtained.

Heaton Norris.—Notice, signed by the clerk to the Heaton Norris Urban District Council and the town clerk of Manchester, appears in the *London Gazette*, announcing the intention of the former body to transfer its electric lighting provisional order to the Manchester Corporation.

Heckmondwike.—On Thursday last week Mr. W. R. Slacke, one of the inspectors of the Local Government Board, held an inquiry into the District Council's application for sanction to borrow £14,000, for electric lighting plant. It was stated that the British Electric Traction Company had agreed to take the electrical energy required for their proposed tramway through the township from the Council's works, and that a good general demand was expected. The scheme included a house-to-house connection, and the price proposed to be charged would average 5d. per Board of Trade unit.

Ingleton.—The Electric Light and Power Company having submitted tenders for the supply of electric light, the Committee recommended the Council to accept a tender for 30 16 C.P. lamps, to be lighted, cleaned, and maintained all the year round for the Council for the sum of £65 per year for three years. This was agreed to.

Leyton.—On account of delay in the delivery of two gas engines, the question of providing plant to cope with the growing demand has become urgent; the District Council has, therefore, authorised the purchase of two boilers, &c., at a cost of £1,368, to supply steam to one of the steam dynamos already ordered. The loan of £30,000, which was applied for in May last, has only been sanctioned by the Local Government Board within the last fortnight, and then only in part; this accounts for the urgency of the matter.

Littlehampton.—The District Council is considering a proposal laid before it by Messrs. W. R. Lees & Co., Douglas, offering to obtain a provisional order and to lay down plant for supplying electricity to the town.

Liverpool.—On 17th inst. a Local Government Board inquiry is to be held into an application of the City Council for sanction to borrow £300,000 for the purposes of electric lighting.

Llandilo.—The District Council has received a report from Mr. J. C. Howell upon the tenders sent in for carrying out the electric light scheme there. Mr. Howell selected two tenders, one from Messrs. Lewis & Fletcher, for overhead cables, and another from Mr. Bertram Thomas, for underground. Both tenders are to be adjusted to place them on the same basis.

London, E.C.—At the sitting of the Court of Common Council last week, says the *City Press*, Mr. Algar (Candlewick) brought up a report from the Streets Committee recommending that in a Bill to be introduced into Parliament next session a clause should be inserted giving the Corporation the power to deal with pipes, cables, wires, &c., under the public ways of the City. The Committee recommended also that a City inspector should be appointed, at a salary of £200 a year, under the Overhead Wires Act. The Court approved.

The town clerk read a letter from the National Telephone Company, asking to be permitted to lay their mains under the streets simultaneously with the Postmaster-General, whose application is under the consideration of the Committee. Mr Algar moved that the communication should be referred to the Streets Committee for consideration. Mr. Deputy Pannell (Bassishaw) having seconded the motion, it was carried.

The Streets Committee recommended, relative to the Electric Lighting Order Confirmation (No. 20) Act, 1899 (Charing Cross and Strand Electricity Supply Corporation, Limited), that Mr. A. A. Voysey should be appointed the electrical inspector under that order, and that the company should be asked to contribute £500 per annum towards the expenses of the inspector.

With respect to applications from the Charing Cross and Strand Electricity Supply Corporation for permission to lay mains, &c., on the south side of Fleet Street, from the City boundary to the corner of Bouverie Street, and on the south side of Bream's Buildings and a portion of Fetter Lane, the Committee stated that they had informed the company that no objection would be offered to the proposed works on their satisfying the Corporation that they had complied in every respect with the City of London Electric Lighting Order Confirmation (No. 20) Act, 1899. The work, moreover, would have to be done under the direction and to the satisfaction of the City engineer.

On the subject of a letter from the City of London Electric Lighting Company in regard to the proposed alteration in the standard pressure of supply, the Committee recommended as follows:—"(1) That the condition agreed to by the Court on October 5th, with regard to the price of supply, be adhered to, and the company be informed that in the event of any abnormal conditions arising, as suggested in their said letter, it would be open to the said company to ask the permission of the Corporation to increase the price of supply; and (2) that the City of London Electric Lighting Company be informed that the means of testing the public and private supply, as at present existing, are not satisfactory, and that a copy of a memorandum prepared by the electrical engineer on the subject

be forwarded to the company, with an intimation that an acceptance of the testing arrangements specified therein shall not prejudice the rights of the Corporation under the Provisional Orders, 1890 and 1891." The Court approved of the recommendations of the Committee without discussion.

The same Committee presented a report relative to an application from the Pearson Fire Alarm Syndicate for permission to lay wires underground, in tubes, across Whitecross Street to the corner of Silk Street. The Committee recommended that the application should be complied with, subject to the terms and conditions agreed to by the Court on July 27th last. The Court agreed.

A special meeting of the Mile End Vestry is summoned for November 27th for the purpose of passing the necessary statutory resolution to apply for a provisional order to supply electricity for public or private purposes.

London, S.W.—There is trouble in store for the Westminster Electric Supply Company; the Vestry of St. George's has received complaints from a number of residents in the neighbourhood of Eaton Square on the score of showers of grit and condensed steam from the chimney of the electricity works, and has resolved to take legal proceedings.

Lytham.—Messrs. Medhurst & Page have presented their report to the District Council as to the cost of establishing an electric lighting scheme for the town. The estimated cost of the installation is £24,000. The consideration of the report was deferred, after a short discussion on the main features of the scheme.

Nantwich.—The District Council on Friday last decided to apply to the Board of Trade for electric lighting powers. Two schemes, one providing for the lighting of the district at a cost of £11,000, and the other for the lighting of the town at a cost of £7,000, are being considered. The expert engaged by the Council estimates that the larger scheme would produce a profit of £1,000 after the third year.

Nelson.—The Corporation having made application to the Local Government Board for sanction to borrow £12,000 for electric lighting purposes, Col. J. T. Marsh, R.E., one of the inspectors to the Department, held an inquiry there last week, to receive evidence in regard to the said application. The money is required for additional plant to meet the growing demand for electric light in the town.

Northumberland County Asylum.—On the recommendation of the Asylum Committee, the County Council has decided to confer with Messrs. Swinney, Morpeth, as to a scheme for lighting the Asylum with electricity.

Nuneaton.—The District Council has decided to apply to the Board of Trade for a provisional order authorising the Council to purchase the undertaking of the Nuneaton Electric Company, Limited, and for other powers.

Oldbury.—The Midland Electric Light and Power Corporation is making proposals to the District Council for the supply of electricity in this district.

Poplar.—The Board of Works had under consideration last week a recommendation from the Electric Lighting Committee to the effect "that the electrical engineer have power to dismiss any member of his staff, and that all appointments be made on that condition." Inconceivable as it would seem to be, this very proper and business-like recommendation was vigorously opposed, and in the end was replaced by an amendment limiting the engineer's summary powers to employés on weekly or hourly wages, while other members of his staff may only be suspended and reported. The weakness of the latter system is well known to all who have had experience in practical work. The best thing to do now, apparently, is to pay *all* the staff by the week or hour, and so bring them within the meaning of the resolution!

Ripley.—The District Council has decided against the proposal to apply for a provisional order for electric lighting.

Runcorn.—The District Council last Thursday resolved to engage an electrical engineer to report as to the supplying of electricity to the town for power and lighting purposes.

Southborough.—The District Council has decided not to concur in the proposed application of the Tunbridge Wells Council for the extension of the area of supply prescribed by its electric lighting provisional order.

Stamford.—The Corporation is considering the question of establishing electricity works in the borough, and has appointed Mr. F. J. Warden-Stevens to advise in the matter.

Tipton.—At a meeting of the Urban District Council of Tipton last week, Mr. Mason asked the clerk if any reply had been received from the Midland Electric Corporation in reference to the proposed electricity station at Tipton. The clerk stated that he had written to the company upon the subject, but had not yet received a reply. Mr. Mason said that since the company had purchased a site in the parish, four Birmingham firms had entered into negotiations for the acquisition of land for the purpose of transferring their business to the Tipton district.

Trowbridge.—The District Council is considering the question of supplying the district with electricity. It is stated that a local firm may undertake the work.

Warrington.—On Wednesday Major-General Crozier, R.E., held an inquiry on behalf of the Local Government Board with reference to an application of the Corporation to borrow £44,966 for electric lighting purposes, and £9,336 for the provision of a central depôt in Parr Street. Evidence was given by the town clerk and other officials in support of this application.

Wolverhampton.—At a meeting of the Council last week a report was presented by the Electric Lighting Committee, stating that the Committee had under consideration a scheme for the extension of the undertaking, involving a considerable capital expenditure, which it was proposed to submit to the Council in December next. Having regard, however, to the extreme difficulty in obtaining electrical machinery, except upon very long notice, owing to the fact that the leading manufacturers are exceedingly busy, the Committee desire the authority of the Council to obtain and accept tenders immediately for two 700-I.H.P. direct coupled steam dynamo sets, at an estimated cost of £11,000. This plant will form part of the scheme previously referred to, but it is absolutely necessary, in order that the plant may be installed previous to the winter of 1901, that tenders for the same should be invited and accepted immediately. The constantly increasing demand for electrical energy, both for lighting and power purposes, renders it extremely probable that the whole of the plant in respect of which the expenditure of £29,000 was sanctioned by the Council in October last, will be taken up in the course of the next few months. The Committee accordingly recommended that they be authorised to forthwith advertise for, and accept, tenders as stated, and to apply to the Local Government Board for their sanction to a loan for the purpose.

The Lighting Committee's report for the year ended March 31st last shows a net profit of £1,004. There are now over 21,000 lamps connected, while the energy supplied to private consumers has increased by 44·77 per cent.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Barnsley.—The Town Council at a private meeting last week was in favour of promoting a Bill next session to construct and work tramways in Barnsley and the districts round about. It seems that powers have been already granted by the Light Railway Commissioners to the British Electric Traction Company. A Sheffield paper which advocates the municipal scheme says:—"It is long since the company announced their intention of applying for further powers for constructing additional lines in the district, in the direction set out in the scheme of the borough surveyor. They will not be able to proceed whilst the Town Council's application to Parliament is awaiting decision." It does not say much for the fair-dealing of the Barnsley Council if, having arranged one thing with the British Electric Traction Company who have incurred expense, it should at this late hour want to rescind its resolutions.

Belfast.—The Council held a special meeting to consider the question of acquiring the tramway system and adopting electric traction.

Cardiff.—It is a pleasing testimonial to the benefits of electric traction to find tradesmen and others petitioning that the proposed route *viâ* Clifton Street and Broadway be not eliminated from the tramway scheme.

Croydon.—The Corporation having agreed to equip the overhead system of electric traction, have now resolved to lease the undertaking to the British Electric Traction Company, Limited.

Dublin.—On 23rd ult. an electric tramcar knocked down two pedestrians (respective ages 60 and 58), injuring them both, so that they had to be detained in hospital. The car driver has been charged with carelessness in the management of the car, and with causing the injuries. He was last week remanded on bail. We do not know what may be the measure of blame attachable to the driver in this instance, but we think that tramway officials should use their best endeavours to prevent reckless driving of electric cars, and bring erratic souls to book.

On 30th ult. an electric car crashed into a cart which was sanding the streets. The horse was thrown, the driver of the cart was flung out, and injuries to his head resulted. Later accounts say that the cart belonged to the tramway company, and that the horse had to be destroyed.

Dudley and Sedgley.—A start has now been made to equip this tramline for electricity, workmen having commenced operations at the Dudley end of the line.

Dundee.—The Tramways Committee last week considered the question of tramway extension to the north of the town. It would be impossible to secure Parliamentary powers during the coming session of Parliament, therefore a scheme drawn up by the burgh engineer was meantime deferred.

Farnworth and Kearsley.—The Urban District Council of Kearsley, near Bolton, has resolved to join the neighbouring authority of Farnworth in the promotion of a Tramway Bill. As to the working of the lines, an arrangement has been made for a term of 21 years. The Council has instructed Mr. Ellis, the Bolton electrical engineer, to arrange with them respecting the equipment.

France.—The central power station in connection with the new electric tramways in Sedan, is practically completed. The lines are expected to be open for traffic within a few weeks.

Glasgow.—The Board of Trade representatives, Colonel Sir Francis Marindin and Mr. Trotter, were to visit Glasgow on Wednesday to inspect the extension of the electric tramways recently completed from Glasgow Cross to Govanhill. It was expected to have cars running from Springburn to Govanhill yesterday.

Last week the trolley pole of an electric car broke at a street corner, and the following car was requisitioned to push up behind so as to get it to Springburn depôt. The second car succeeded in getting off the rails and blocked the other lines, so that traffic both ways had to be suspended for about an hour.

Gomersal.—At the meeting of the District Council last week, it was reported that the British Electric Traction Company had made an agreement with a deputation of the Council to apply in the coming session for powers to construct a branch from Liversedge to the Gomersal boundary at Birkenshaw, in connection with their electric tramway from Dewsbury to Cleckheaton, and to carry out the works within two years from the date of the order. A draft agreement to this effect was submitted, and it was understood that it would receive the seal of the Council after its clauses had been gone through in committee.

Halifax.—New York *Electricity* for November 1st, says:—"Mr. H. Whitley, vice-chairman of the Borough Tramway Committee of the Halifax (England) Corporation, accompanied by Mr. H. F. Street, electrical engineer, returned to England on the 21st ult. after a six weeks' tour in this country. They had been investigating the subject of electric traction, and were deeply impressed with what they saw in our principal cities."

Hawaii.—We read in the *Western Electrician* that construction work on a new railway to be built on the island of Hawaii will soon be commenced. The road will be known as the Kohala and Hilo railway and will connect the port of Hilo, the principal city on the island, with Mahukona and Kohala. It will have a total trackage, including branch lines, of 130 miles, and will open to cultivation a large fertile territory heretofore inaccessible on account of the lack of transportation facilities. The road is to be operated by electricity, which will be generated by water-power. Three power plants will be built, each plant to be of sufficient size to furnish power to run the entire road in case of necessity. These plants will be located at either end and near the centre of the road. It is expected that the company will start with 100 20-ton cars and six electric locomotives, similar to the type in use in the Baltimore and Ohio tunnel at Baltimore. The company has been incorporated under the laws of the Hawaiian Islands, and is capitalised at $3,000,000, the greater part of the stock being held by Americans. American and Hawaiian capitalists are interested in the scheme.

Hemel Hempstead.—It is stated that three parties (the British Electric Traction Company is one) have offered to lay down a tramway here.

Hungary.—The authorities of the Raab-Oedenburg-Ebenfurther Railway are about to carry out some experiments with electric traction, by means of accumulators, on the railway between Esterhazza, Kis, and Czell.

Ipswich.—A meeting of owners and ratepayers has approved the Council's proposal to purchase and extend the tramways, and employ electricity for working them in connection with the lighting scheme.

Liverpool.—The Walton District electric tram service was inaugurated on 5th inst. The route commences in Castle Street at the junction of Lord Street, and proceeds down Lord Street, along Whitechapel, across the Old Haymarket, and up Byrom Street, Scotland Road, Kirkdale Road, and Walton Road to Spellow Lane, returning by the same thoroughfares as far as Byrom Street, where the line turns down Dale Street and so into Castle Street. Probably something like 70,000 people travelled on the cars during the day. Eighteen cars are employed to secure a practically continuous service.

Llanelly.—The Borough Council last week decided to adopt a scheme by which the British Installation Company will acquire powers to light the town with electricity and lay down a system of electric traction which will embrace the outlying villages of Felinfoel, Llwynhendy, and Pwll. The Council agree to dispose of their provisional order to the company, and will assist them in application in Parliament for the necessary powers. It is understood that the scheme will involve a total expenditure of between £80,000 and £100,000.

London.—The *Daily News* says that next week the London County Council will receive from its Highways Committee a report recommending that, in connection with the project for embanking the Thames from Victoria Tower Gardens to Lambeth Bridge, a double line of tramways, to be worked by underground electric traction, be constructed, at an estimated cost of £6,000, along Millbank Street, which, under that great improvement scheme, is to be widened to 70 feet.

Manchester.—On Tuesday evening last, Mr. Ernest T. Williams, assistant electrical engineer to the Corporation of King's Lynn, gave a lecture to the members of the Union Chapel Mutual Improvement Society, Manchester, on "The Rival Systems of Electric Tramway Traction." Manchester hopes before long to possess electric trams, and for some time past a controversy has been waging in the city newspapers on the relative merits of the different systems. Consequently, a considerable interest was taken in Mr. Williams's lecture. Mr. Alderman Bax occupied the chair. He recommended the Manchester citizens to rest assured that in carrying out the "trolley" system of tramway traction, the Electrical Committee of the Manchester Corporation were, under the circumstances, adopting the most suitable system for their city. The lecture was illustrated by means of lantern slides.

The lease of the tramways by the Manchester Carriage and Tramways Company expires in April, 1901. It is hoped, however, that arrangements may be effected with the company under which it may be possible for the Corporation to start running some of the electrically propelled tramcars some time during the year 1900. If anything should be accomplished in this direction, it is probable that the first cars will be run on the Cheetham Hill Road, Rochdale Road, and Bury New Road routes. On the invitation of the Tramways Committee, a large number of the members of the City Council and others interested inspected on Tuesday and Wednesday samples of the tramcars from which the type of car to be ultimately adopted in Manchester will be evolved.

Manchester to Liverpool.—From the *Manchester Guardian* we gather the following notes regarding this proposed electric railway scheme:—Another step towards the realisation of the scheme for an electric railway between Manchester and Liverpool has now been taken. A syndicate, with a capital of £40,000 in 400 shares of £100 each, is being formed "for the purpose of taking all the necessary steps in connection with applying for and obtaining in the ensuing session of Parliament an Act for the formation and incorporation of a railway company; for the construction and working of a high-speed electric railway between Manchester and Liverpool, on what is known as Behr's Monorail system." The preliminary prospectus states that "at present the Exploration Company, Limited, of London, holds the right of option of acquiring Mr. Behr's patents, but they have concurred with Mr. Behr in entering into an agreement with the syndicate, under which, in the event of the proposed Act of Parliament being obtained and the requisite capital subscribed, Mr. Behr and the Exploration Company bind themselves, at the request of the syndicate, to grant to the railway company to be formed, a license for the use of the invention for the purposes of the railway on any one of the following terms at the option of the directors of the railway company:—

1. A cash payment of £60,000, to be made when the railway is opened throughout for public traffic.
2. Twelve yearly payments of £6,000 each, the first to be made when the railway is opened throughout for public traffic.
3. A yearly royalty to be paid in perpetuity by the railway company of 25 per cent. of the net profits in each year, after payment out of the profits of each year of 5 per cent. on the paid-up share capital of the railway company for each year.

Under the above agreement, and as part of the terms of the assent of the Exploration Company thereto, and as remuneration for their trouble and services in connection with the business, that company is to be entitled to one-third of all net profits of the syndicate after the holders of the original share capital of £40,000 shall have received, either by way of dividend on their shares or in any other form from the syndicate, either by distribution of capital, or assets, or otherwise, an amount equal to the amount paid up in cash on the £40,000 of share capital. In order that the survey of the line may be completed, and the Parliamentary plans be prepared and deposited within the time prescribed by the Standing Orders, the survey has already been commenced, the Exploration Company having become responsible for the cost, which, with the other expenses incurred in connection with the business, are to be repaid by the syndicate. It is not anticipated that so large a sum as the £40,000, at which the capital of the syndicate has been fixed, will be required, but it has been thought prudent to provide for that amount, so that the syndicate might be placed in a strong position. The Exploration Company have requested Messrs. Mather & Platt, Limited, to give them the advantage of their wide experience and resources in carrying out, at their works, such tests of electrical plant as may be found necessary, and in perfecting details of the same; and in consideration of their having agreed to do so, the Exploration Company have entered into the preliminary contract with Messrs. Mather & Platt for the construction of the electrical and power plant for the proposed railway upon terms which the directors consider satisfactory. The directors of the syndicate are Mr. J. S. Bergheim, London (director of the Midland Electric Corporation for Power Distribution, Limited); Mr. E. Tootal Broadhurst, Manchester (Messrs. Tootal Broadhurst, Lee & Co., Limited); Mr. D. Cunningham, Liverpool; Mr. J. H. Macmillan, Manchester (managing director of Messrs. Salis Schawbe & Co., Limited); Mr. William Mather, Manchester (chairman of Messrs. Mather & Platt, Limited); Mr. William Oulton, Liverpool; and the Hon. R. J. Strutt, of Witham, Essex.

Perth (Australia).—The *Financial Times* says that the Perth electric trams have started running, and promise to be a great success. At present only one line has been constructed, but the cars are being well patronised.

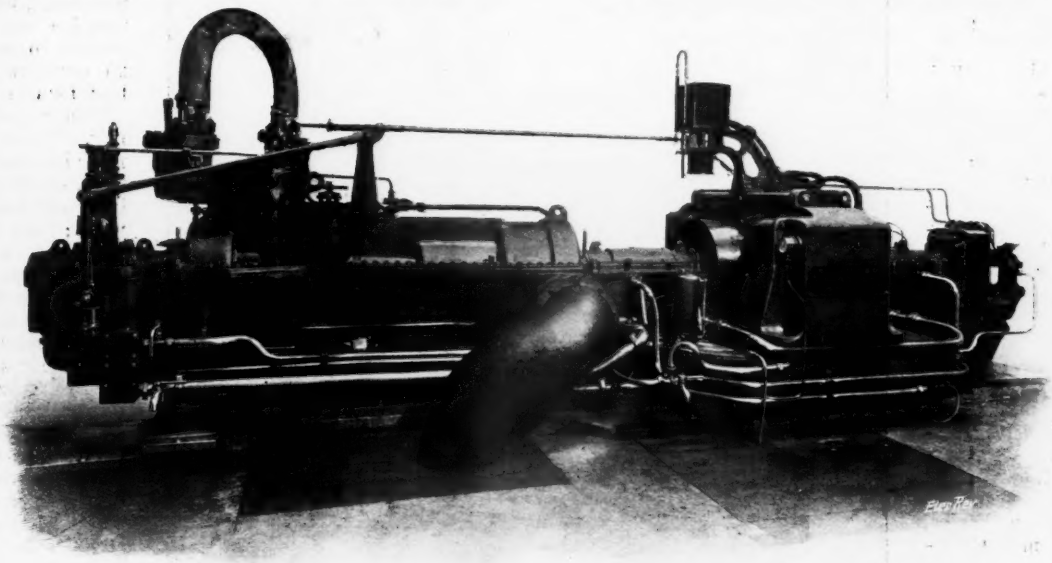
Portsmouth.—The Town Council on Tuesday approved of the intention of the Tramways Committee to make application to the Board of Trade for a provisional order under the Tramways Act, authorising the Council to make certain extensions. At a meeting of the Electric Lighting Committee on Tuesday the question of the cost of producing current at the electric lighting station for the purpose of electric traction was under consideration. The cost of producing 1,500,000 units of electricity for tramway purposes was estimated at £5,637 10s., and eventually the Committee decided to offer to sell it to the Tramways Committee at 1$\frac{1}{16}$d. per unit, which would yield £6,640 12s. 6d., and give a profit of £1,003 2s. 6d. The Committee, however, made the further offer that they would not accept or require more than £350 profit per million units.

(Continued on page 765.)

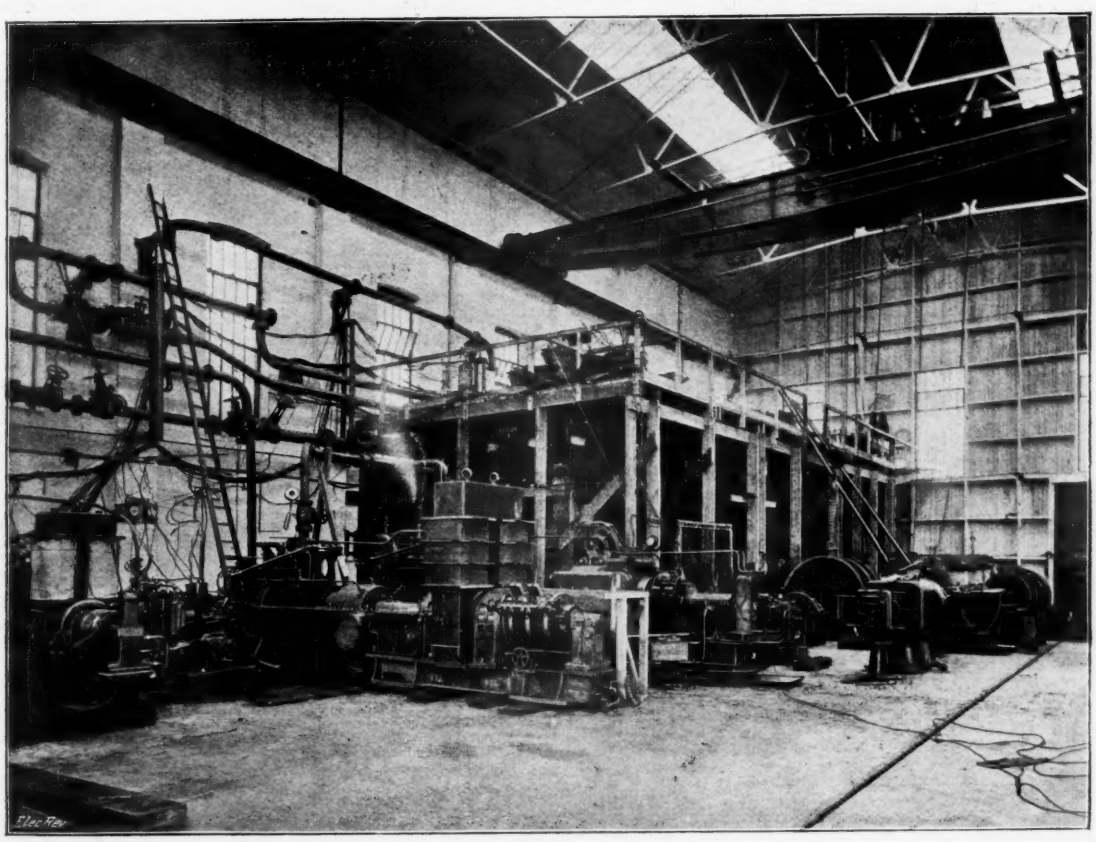
MESSRS. C. A. PARSONS & CO.'S HEATON WORKS.

There can be but few of our readers who are not familiar with, at least, the external appearance of the Parsons steam turbines; these extraordinary machines, the first practical steam turbines to be developed, possess a kind of fascination of their own, spinning as they do, silently and smoothly, at a velocity which is almost inconceivable!

The turbine, in its earlier days, had a hard struggle for existence; British engineers, accustomed to low speeds, looked askance at such a startling innovation as was implied by speeds of 8,000 and 10,000 revolutions per minute, at which the small machines turned out 12 years ago used to be run. Like many another, however, the inventor, the Hon. C. A. Parsons, was not to be daunted by a somewhat cool reception; he steadily went on experimenting, constantly increasing the size and output of his engines, until the value



500-kw. Turbo-Alternator.



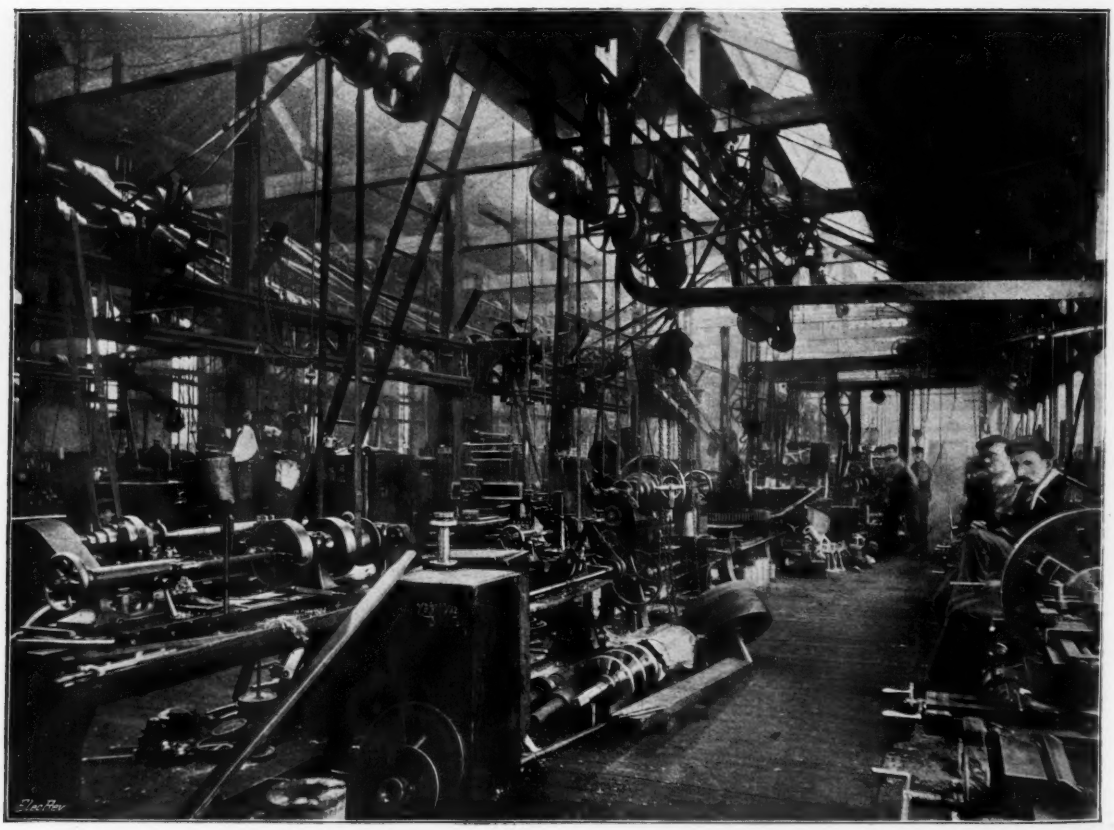
Test House.

of his work was recognised, and his machines had won an assured position in the eyes of the engineering world.

That this has been attained is evidenced by the fact that at the present time the work in hand at the Heaton Works amounts to a total of 9,000 KW., and includes two 1,000-KW. turbo-alternators for the municipal authorities of Elberfeld, Germany; two 500-KW. sets for the Cambridge Electric Supply Company, Limited; one 500-KW. set for the Chatham, Rochester, and District Electric Lighting Company, Limited; two 400-KW. sets for the Newcastle and District Electric Lighting Company, Limited; and plants for Woolwich Electricity Works, Morecambe Corporation, Shipley Urban District Council, Morgan Crucible Company, Limited, London, and various other clients.

Fitting and Erecting Shop.

The view which we give of a 500 KW. turbo-alternator and exciter, which was recently supplied to the Newcastle and District Electric Lighting Company, shows well the general arrangement which is typical of these machines. A similar set (for Cambridge) was undergoing a 6-hour trial at the time of our visit, and may be partly seen in our view of the new test house; the normal output was 250 amperes at 2,000 volts, 2,700 revolutions per minute, 90 periods per second, but the machine was guaranteed to run at 25 per cent. overload for two hours without undue heating. The alternator has four field poles, of laminated iron, with cast-iron yokes; the armature has a perforated core, provided with special ventilating devices, and massive collecting rings with copper gauze or brass wire brushes—usually the latter. The exciter, which is mounted on the main shaft, gives 24 amperes at 88 volts, or 0·4 per cent. of the output of the alternator. The governor, which is of the same type as has been in use almost from the commencement, consists of a solenoid connected as a shunt to the terminals of the exciter armature; this acts on a light soft iron core coupled, by means of a long lever, to a mechanical device, which admits steam to the cylinder in



Turning Shop.

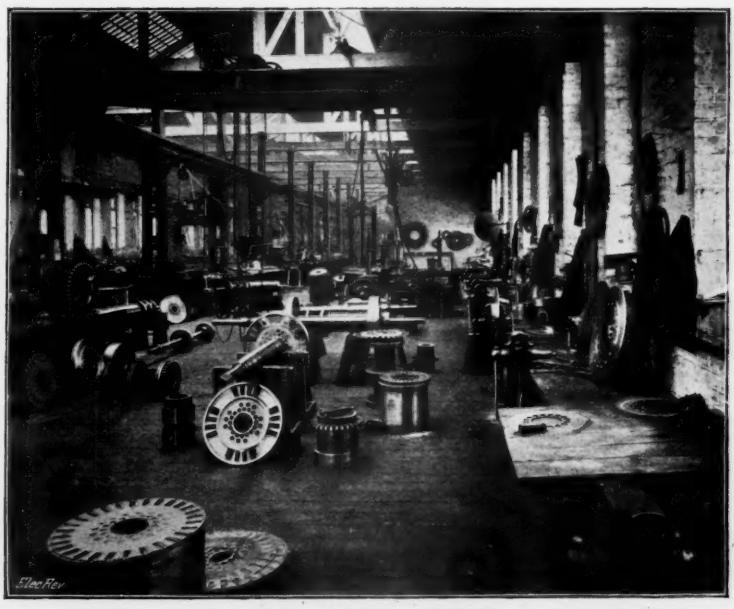
puffs of longer or shorter duration. By adding to the solenoid a thick wire coil in the main circuit, acting in opposition to the shunt coil, the characteristic curve of the alternator may be given any desired form, the advantages of compound winding being thus obtained.

The 500-KW. set in question is combined with its own surface condenser, the latter being underneath the bedplate, while the air and circulating pumps, which are mounted on the frame of the turbine, as well as an oil pump for forced lubrication, are all driven by means of worm gear from the main shaft. A "run-away" governor of the ordinary centrifugal type is driven in the same way, and would cut off the steam in case of accident before an excessive speed was attained.

The full load was thrown on and off in our presence, without any perceptible effect upon the running except a slight change in the pitch of the sound emitted; the terminal pressure only varied about 2 per cent. A load of 585 KW. was also put on, with no marked effect. The steam consumption was afterwards worked out, and was found to be 23·2 lbs. per KW.-hour, condensing; no part of the alternator or exciter rose in temperature to the limit of 70° F. above the surrounding air, which is guaranteed by the makers.

Armature Winding Shop.

In our view of the test house, partly concealing the 500 KW. set, will be seen a 200 KW. two-pole direct current machine, running at 1,400 volts, 2,200 revolutions per minute, for Morecambe. This dynamo is self-exciting as a shunt wound machine, the field magnet bobbins being wound in sections for greater facility of insulation and security against breakdown. The armature is a smooth core drum, bound with piano wire, with barrel winding (which was invented in Messrs. Parson's shops) at the ends. The commutator is very strongly bound together at the middle and ends with massive steel rings. The brush-holders are carried in a very heavy cast-iron frame, and are adjusted by means of screw gear under the commutator, from one side. It is noteworthy that the brushes on all these machines are held in contact with the collectors by gravity, heavy tails being cast on the holders for this purpose. The turbine is generally similar to the one already referred to, but the condenser is in this case separate.



Armature Building Shop.

The small 8-KW. two-pole plant close by is destined for H.M. torpedo-boat destroyer *Viper*, which is being fitted with turbine engines of 10,000 H P. for the British Admiralty by the Parsons Marine Steam Turbine Company, Wallsend. The dynamo is rated at 100 amperes, 80 volts, at 4,000 revolutions per minute. The set includes condenser and pumps, as in the case of the 500-KW. set.

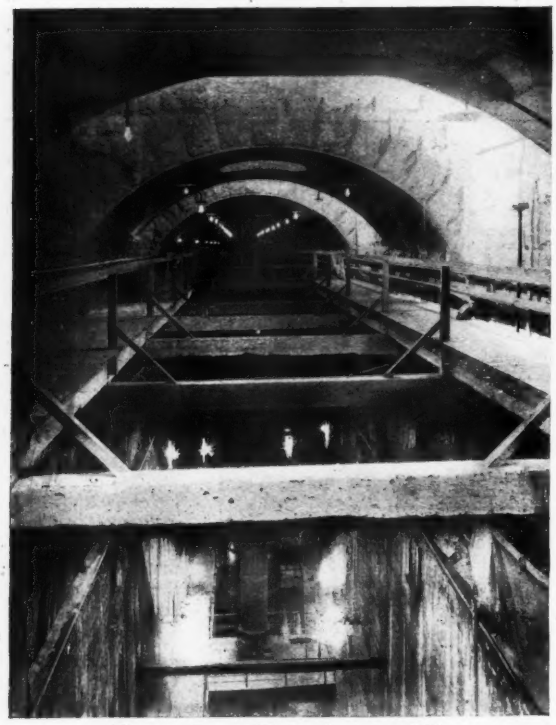
The most striking feature of the test house, however, is the pair of 1,000 KW. generating sets for Elberfeld, which are being erected in the background. Each of these machines is of the four-pole type, giving 250 amperes at 4,000 volts, 1,500 revolutions per minute, 50 periods per second, and is complete with its own surface condenser and pumps; this is the reason why the machines appear to stand so very high — when they are in their final position the condensers will be below the floor level. It is a remarkable fact that, though these large sets are to be tested completely in all respects, they will not be fixed down in any way. The turbines for these sets have both high and low pressure cylinders, as in the large marine types.

The test house, which measures 105 feet × 50 feet, and is very lofty, is provided with two travelling cranes lifting 5 and 10 tons respectively, and with a large surface condenser, pumps, and two measuring tanks, for carrying out accurate tests up to an output of 2,000 KW. The circulating water is supplied by a Parsons propeller pump, running at 4,000 revolutions per minute, and driven by an electromotor; it might, of course, be driven by a steam turbine equally well. Although the propeller, which is very similar in appearance to a marine propeller, is only about 6½ inches in diameter, it is capable of delivering 90,000 gallons of water per hour against a head of 12 feet. Close to the test house there is a large cooling pond for the condensing water.

The boilers are of various types and ages, with a combined capacity corresponding with the electrical output of 2,000 KW. Here, again, we find a turbine driving a fan at 3,000 revolutions per minute, and inducing a draught of 3 inches of water.

The machine shops are in two bays, 380 feet long × 50

feet wide; they consist of turning, fitting, and erecting shops, armature building and winding shops, and tool shop.



Niagara Power Works (see page 765).

There is also a brass foundry, forge, pattern shop and store, and a store for materials.

In the turning and fitting shops are numerous boring, turning and planing tools, forming the usual equipment of an engineering works; the more interesting features are the turbines and dynamos in course of construction, with which the shops are crowded. The whole of the parts of the turbines are made in these shops; we noticed large pump pistons and valves, gun-metal worm wheels, cylinders and spindles being fitted with blades, of various sizes up to 1,000 KW. A three-phase plant of 150 KW. was being built for a power transmission plant at a large Yorkshire colliery; this may be looked upon as a sign of the times. One of our photographs shows three sets for the Morgan Crucible Company, for power transmission; two of these are of 150 KW. each, the dynamos being coupled tandem, and one of 60 KW. Here, again, the condenser and pumps form part of the machine. No provision whatever is made for holding-down bolts. The brush gear, which is very massive, is so arranged that it can be lifted bodily away without disturbing any other part of the machine.

The bedplate of the 500-KW. set, of which several examples are in hand, is cast in one piece, weighing 5 tons; this is the heaviest part. The total weight of a 500-KW. turbo-alternator, without condenser, amounts to 18 tons; this works out to about 80 lbs. per KW.

In the armature winding shop armatures for 500 and 1,000 KW. alternating were in hand, as well as various direct current armatures from 400 KW. downwards, the latter being of the smooth core type. On account of the high speed and small surface, the question of temperature rise is in these armatures of great moment; hysteresis and eddy losses in particular have to be carefully provided for by means of ample core ventilation. In our view of this shop, a 500-KW. armature may be seen suspended in the sling. The two small armatures in the foreground are of special interest; one of these is a 12-KW. armature, built in 1887, and running at 10,000 revolutions per minute, while the other is for 16 KW., built in 1889, and running at 8,000 revolutions per minute. They appear to be as good as new, in spite of the enormous number of revolutions that they have made at these high speeds! The speeds in use at present are far lower; but this, we were informed, is merely on account of the noise inseparable from the extra-high speeds.

Transformers are also built in these shops, up to an output of 50 KW.

The machinery is driven in part by a gas engine, but the power required has outgrown the capabilities of this machine, and several electromotors have been put down, of 4, 12, and 18 HP, to assist in driving the shafting. The pattern shop is also electrically driven.

The tools are served by three 5-ton cranes, which traverse the whole length of the shops.

A siding from the main line of the North-Eastern Railway runs right into the works alongside the machine shops, and provides a ready means of despatching the finished products to their destination.

So great is the pressure upon the shops, that the works are about to be quadrupled in size, and will ultimately be increased to six times their present extent. A space of 11 acres is available for extensions; the building now in progress consists of two bays, and measures 388 feet × 80 feet, while new offices have already been erected, and will shortly be occupied; electrical driving will be adopted throughout the new workshops. The rapid advance, of which these large extensions give evidence, is full of significance, indicating the extreme prosperity of the electrical

Niagara Power Works (see page 765).

engineering profession, and the fact that our manufacturing firms are determined to take steps to cope with the press of work resulting therefrom. We hope that the new shops will soon become as full as the present ones, and that the flowing tide may never turn!

NIAGARA POWER WORKS.

The announcement that the Niagara Falls Power Company is to build a new wheel-pit and power house naturally directs attention to the things this company has accomplished since it broke ground for its tunnel on October 4th, 1890. The first section of the wheel-pit and power station were hardly completed before the contracts were let for an extension, and only this summer the company has added a new section to its transformer station.

One of the illustrations on the opposite page shows a view down into the wheel-pit. This view is one taken beneath the stone-arched floor of the dynamo room, and through the gloom of the pit may be seen the turbine shafts and the huge penstocks that supply the turbines with water.

The new wheel-pit is to be connected to the main tunnel by lateral tunnels. There is no more interesting view at Niagara than that in the gorge illustrated in our other photograph. Here is to be seen the portal of the tunnel of the Niagara Falls Power Company. It will be observed that it sends a terrific force of water out into the lower Niagara river, and the stream from the tunnel shoots right across until it almost washes the Canadian shore. The view is one looking right into the tunnel from the Canadian bank.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page 760.*)

Preston and Blackburn.—For the tramways in Preston it is understood that the Corporation favour a 4-foot gauge and the overhead trolley system of electric traction. No absolute decision as to the working of the lines by the Corporation, or leaving them to a company, has yet been arrived at, but the feeling in the town is distinctly favourable to municipalisation. In Blackburn a feeling exists that the two towns should be brought into connection. This would, undoubtedly, be a great public convenience, and it has the merit of being perfectly practicable. The 4-foot gauge, which Messrs. Lacey, Clirehugh & Sillar recommend for Preston, is the same as now exists at Blackburn, and a length of six miles only will separate the terminus of Blackburn's system from that of Preston.

Putney.—The Light Railways Commissioners have been memorialised by the Conservators against the County Council's scheme for a trolley line across Putney Heath towards Kingston.

Radcliffe.—On Monday the District Council held a special meeting to consider a recommendation of the Electric Lighting Committee, that a provisional order should be obtained for electric traction. The Committee had been in communication with the Manchester Corporation on the matter. The latter were not allowed to lay lines in Radcliffe, but if Radcliffe laid the lines Manchester could work them for a period of 21 years, and would pay the entire cost of the line with interest on the money borrowed, in addition to paying the cost of obtaining a provisional order. As a matter of fact, Radcliffe was applying for a considerably greater length of line than could be leased to Manchester. No arrangements have as yet been made with Manchester. The minutes of the Committee were eventually adopted without opposition.

Royton.—The District Council on Monday last resolved to take steps for establishing electricity works in the district in connection with the tramway scheme, and for other purposes.

South Lancashire.—Notices were published on Monday last of the South Lancashire Tramways Company's intention to promote a Bill in the next session of Parliament to acquire powers for the construction of an important network of new tramways, tapping a large industrial district, and affecting 18 different local authorities. One main line will run from St. Helens through Newton and Leigh to Bolton; another through Tyldesley to Swinton, there to connect with the Manchester tramways; and a third through Atherton and Hindley to Wigan. The scheme is enlarged from the company's original light railways proposal.

Switzerland.—The *Times* says that the completion has just been celebrated of a funicular railway up to the Schatzalp at Davos-Platz. It commences at the rear of the Kurhaus, and is about 2,200 feet long. The force used to propel the cars is electricity, which is generated in the valley near the ice rink by dynamos driven by gas engines (an English patent), the mixture of air and gas being exploded, not, as is usual, by a jet of gas, but by an electric spark. This is one of the first funiculars in Switzerland to use electricity as a motive power. The line is an excellent piece of engineering, and many ingenious devices are adopted to ensure safety and promote easy and smooth working. The line cost more than double the price estimated—the amount expended being about 500,000 francs—and, as the sanction of the Federal Government has been sought to increase the fares fixed in the original concession, the railway will not be fully opened until perhaps December. The line can be used, however, by parties sufficient to fill a car—32 persons—and the cars are now running daily. An electric tramway is shortly to be inaugurated between Platz and Dorf.

Tipton.—A meeting of the Urban District Council was held last week, when a report was submitted by the Tramways Committee, which dealt with the proposals of the British Electric Traction Company in their efforts to provide electric tramways for the district. Mr. J. A. Lycett had attended the Committee meeting on behalf of the company, and had stated that it would not be worth the company's while to pay a wayleave. In reply to questions, Mr. Lycett stated that the company had not agreed to pay wayleaves in connection with the South Staffordshire undertaking. If the Council, however, would forego the concession he had previously offered, he would recommend the company to pay a wayleave. The Committee ultimately adopted a resolution recommending that the Council defer concluding arrangements with the South Staffordshire Tramway (Lessee) Company, so as to give them an opportunity of offering terms in the form of a wayleave, or annual payment, towards the cost of repairing the highways over and along which the tramways were laid.—The report was adopted.

Wakefield.—The Council on 6th inst. considered the proposals to promote a Bill for the construction of a tramway system for the city and district. The scheme was shelved.

Wolverhampton.—The Tramways Committee of the Town Council have prepared a report dealing with the question of constructing a tramway track to Heath Town on a surface contact system. The method is the invention of Mr. Thomas H. Parker (son of Mr. Thomas Parker), who thus describes it:—

The system consists essentially in a number of metal studs placed on the track between the two tramlines, these studs being approximately somewhat less than the length of a car apart. The studs project slightly above the normal level of the road setts, but not sufficiently to form an obstruction. Underneath the car is a bar runner, or "skate," slightly longer than the distance between the two studs. This runner slides on the surface of the studs, making contact with one before it leaves the other, and if the studs are connected with the main cable conveying the current of electricity from the generating station, the car can collect the current continuously as it moves along the line. So far, this is simple enough, but the difficulty lies in the fact that studs cannot be left permanently connected with the main conductor, otherwise the leakage in wet weather would be very great, and if anything like a practical voltage were used, horses would be subject to dangerous shocks, hence the necessity that all studs should be dead, with the exception of the one from which the car is collecting the current. When a car reaches a stud, it must be put into circuit, or made alive, and cut off when it leaves it. This involves the use of a switch at each stud, to be operated by the car. The means employed to operate these switches mechanically, and with certainty, necessitates a small slot in the road. This is formed by placing an extra rail alongside the ordinary tram rail in such a manner as to leave a slot of, say, ¾ inch, and provides a small conduit, which, being only the depth of the rail, does not interfere with the laying of pipes, or those already laid. The switch is placed in an iron box below the ground close to the slot, on either side of the rails, and carries on its spindle a star wheel, with four arms which project up into the conduit. At each end of the car is a tongue, or wiper, which projects down into the slot. As each wiper passes a switch it moves the star wheel a quarter of a revolution. The first quarter of a turn switches the current on, and the second switches it off again in whichever direction the car is moving. The star wheel and wiper are of such a form as to make the movement certain and practical. The current required from each switch is only sufficient to supply one car at a time, hence it need only be small, and both that and the star wheel, which are connected together, can be removed, examined, or replaced in a short time without interference with the traffic. Every part necessary can be made watertight and danger proof.

The system has been exhibited to the Tramways Committee by means of a working model, but they delayed issuing specifications for the construction of the proposed new tramway pending the construction of an experimental tramway on the land adjoining the works of the syndicate in Wednesfield Road, Wolverhampton, with which the invention is connected. The syndicate propose that three-quarters of a mile of track shall be laid on the Wednesfield Road to test the system. The Corporation will have, in any case, to construct an ordinary tramway there, and the syndicate propose to put in the extra line and the electrical work necessary at their own expense, and if the system is not adopted, to remove it and restore the track to its normal condition. The borough surveyor estimates that the cost to be borne by the Corporation for the construction of this portion of the track, will be £3,800. The committee strongly support the experiment, being of opinion that it will enable them to determine whether a surface contact system has been invented, which will prove both practical, thoroughly efficient, and inexpensive, points which have handicapped all previous forms of this system. Should it prove effectual, the committee will, no doubt, adopt it throughout their various extensions, as their desire is to obtain, if possible, an underground system, which has the merits of the overhead system, without the objections offered by overhead wires and poles.

TELEGRAPH AND TELEPHONE NOTES.

Cables in War.—The *Standard's* New York correspondent telegraphs that the annual report of Mr. Greely, the chief signal officer, which has just been published, contains passages of interest to several English cable companies, and also touches upon telegraphy during the war with Spain. Mr. Greely recommends the laying of a cable immediately between Cuba or Porto Rico and the United States, in order to avoid the passing of messages over lines belonging to English corporations. Mr. Greely estimates that the cost of such a cable would be $600,000. He foreshadows the laying of a cable shortly between Formosa and Luzon, thus giving an alternative route to that afforded by the Eastern Company. A Pacific cable scheme is supported as being necessary, equally for military as for commercial purposes. Mr. Greely supplies a fresh reason for Admiral Dewey's failure to use the cable to Hong Kong after cutting it at Manila. The Hong Kong end was sealed by the Eastern Extension Company upon the demand of Spain, whose subsidy made compliance prudent, but when the company protested against the United States constructing cables in the Philippines, an adverse report by Mr. Greely was followed by a denial of the rights it claimed in the Archipelago. Mr. Greely proposes that an international cable conference should be called in order to consider the questions of rights, privileges, and immunities during war, and to formulate a universal code. He approves of the suggestion that wireless telegraphy should be employed in the United States possessions in the West Indies.

Duplicate Cables.—The Eastern group of companies who so warmly advocate duplication of all cables would do well if they employed the cable now at the Cape on board the ss. *Anglia* to duplicate the broken-down Mozambique-Delagoa Bay cable. Should they have already started to lay this cable from Cape Town towards St. Helena, it may not be too late to telegraph to the ship to cut and buoy. This may yet be done, as the cable from the Cape to St. Helena is about 1,000 miles longer than that required to duplicate the Mozambique-Delagoa Bay cable, originally laid 20 years ago.

Edinburgh Telephones.—The Lord Provost's Committee of the Town Council has considered the expediency of making an arrangement with the National Telephone Company in connection with the telephone service within the city. After hearing explanations by the town clerk, the Committee considered it would be expedient in the public interest to enter into a provisional agreement with the company, which would safeguard the rights of the Corporation in their streets, give a more efficient telephone service, and an alteration in rates which would benefit subscribers and lead to an extension of the benefits of the service. There would also be a substantial rent paid to the Corporation by the company. The agreement would expire with the company's license in 1911. A clause would be inserted in the agreement protecting the rights and position of the Corporation at that date.

Indian Telegraphs.—*Indian Engineering* says that the Government of India's review of the operations of the Telegraph Department last year is a record of sustained advance and successful administration. The traffic was somewhat lighter than in the previous year, which was an altogether abnormal one, but was larger than any year preceding that, the total number of messages transmitted being over 4½ millions, while the average speed of transmission on the principal lines was 23 minutes, against 26 minutes in the previous year. One of the features of the year was a considerable extension of telegraph facilities to outlying districts, where 94 new offices were opened in co-operation with the postal authorities. The report ends with an appreciative reference to the valuable services rendered by Mr. Reynolds and to the success with which the Department has since been working under Mr. Pitman.

Reasonable Rates v. Monopoly.—On Tuesday Sir Edward Sassoon, M.P., delivered his inaugural address as president of the Folkestone Chamber of Commerce, and as chairman of the Imperial Telegraph Committee of the House of Commons, he made some interesting remarks on the subject of Imperial telegraph communication, to the *Times* report of which we are indebted for the following somewhat full extract:—The question of revision of high telegraphic rates to our colonies and dependencies abroad has very seriously engaged my attention. The Chancellor of the Exchequer, to whom I introduced a House of Commons deputation, promised to lay before the Cabinet the prayer of the deputation for a thorough and searching inquiry. The recess and the present anxious time had adjourned the matter, but it was not shelved. The telegraph companies must not put off the commercial and social bodies of the community with indefinite promises and still more meagre and indefinite performances. We say they have a virtual monopoly; they hold up their hands with horror. Let me give you one instance. The companies pay annually a sum of £7,000 to the Turkish and Egyptian Governments for the so-called use of a telegraph line between Constantinople and Cairo. Now, what use do they make of that line? Practically none, that is, because they desire to prevent others from profiting by the existence of that line by the despatch of messages at a tariff far cheaper than theirs. Does not this artificial and arbitrary method prevent competition, and, if competition is hindered, is not a monopoly created thereby? Another point. A telegram can be sent from London to Fao, at the head of the Persian Gulf, at a cost of 6½d. per word, but thence by cable to India, not much more than a third of the total distance, the charge leaps up to 4s. Does that not savour of monopoly? It would certainly seem so, when we find that the charge per word from England to Gibraltar over a cable the same length as that from Fao to Karachi is only 3½d. or 12 times cheaper. The curious thing is that the line from Fao to the Indian frontier is the property of the Indian Government; so that, when that Government is working in the direction of revision, we are not justified in asking why this unholy collusion has been, and is at the present moment, allowed to exist to the great detriment of our commerce. When the inquiry is instituted light will be thrown upon the reasons why the Turkish land lines along the Euphrates Valley are so useless to Indian traffic. I asked the Foreign Office for a copy of the agreements entered into between the Turkish Government and the cable companies, which was refused, and yet when recently the German bankers connected with the Anatolian Railway desired to lay a cable in the Black Sea between Kustendji (in Roumania) and the Bosphorus, the Eastern Telegraph Company objected, and our Ambassador at Constantinople supported this protest, and demanded from the Porte a copy of the agreement under which this cable was to be laid. What is the result of such action? Simply the squeezing out of competition and the loss of a prospect of lower rates to India. Then it has been bruited about that the Indian Government, through their representatives here, are carrying on negotiations with the telegraph companies for a reduction of rates on the basis of the grant of a subsidy to them, the companies. Are we to understand that no abatement of rates can be obtained without the imposition of fresh burdens on the community, and, what is still more obnoxious, the conclusion of an agreement for a prolonged period which may confirm the monopoly against which we now protest? Some people make a great point of the utility, strategically speaking, of an all-cable line in time of war. We join issue on that subject. Sir Charles Dilke showed that the all-British cable was a myth, because the bulk of the wires are switched on in Lisbon and other places which form no part of our Empire, and I alluded to the undoubted vulnerability of cables and the ease with which they can be cut, instancing the severing of the cables within the immediate sphere of hostilities that prevailed during the Spanish-American war. This statement Lord Tweeddale thought right to traverse, and I thereupon took steps to get a corroboration of my facts, and I hold in my hand an account written by Lieutenant Cameron McR. Winslow, the American naval officer who, while under fire, actually did during May of last year sever two of the Cuban cables. I will not further emphasise this point, but as chairman of the company to which the cable from Hong Kong to Manila belongs, Lord Tweeddale hardly needs to be reminded that this cable was cut by Admiral Dewey. This strange and inexplicable contradiction throws a lurid light upon the straits to which these companies appear to be reduced in buttressing their unjustifiable tariffs. It is noticeable that, while using every influence which they command, and while appealing to our own Government for support at ever turn, on the general grounds that their lines are British, that the Government should protect them abroad, and assist them in obtaining and rendering more secure their foreign concessions, the Eastern group of telegraph companies and their associates use the position so secured to bleed their supporters to the uttermost. The Government and the British public may plead in vain for a decrease in the established tariff to the East, and I am afraid that the many occupations of our Government departments have made these departments blind to the fact that, in assisting the pseudo-patriotic aims of the Eastern Telegraph group, they have been weaving for themselves a web that tightly enmeshes the best interests of that public whom they doubtless desire to serve. I am determined that, so far as lies in my power, this scheming shall at least be carried on in the full sunlight, and subjected to such criticism as may prevent us from falling deeper into the quagmire of monopoly. I am not without hope that, when thoroughly alive to the circumstances, Her Majesty's Government will take up a strong position and insist that past and present favours granted to these companies shall be paid for by the establishment of reasonable telegraph rates between Great Britain and our Eastern Empire, and that failing such treatment all Government assistance to the existing companies shall cease, and that competition shall be encouraged, instead of being discountenanced, as has been the case up till the present hour. When receiving a deputation from the Eastern Telegraph group recently, Mr. Chamberlain pointed out to the deputation that, given any crisis in South Africa, he had noticed that their cables broke down. On the same occasion Sir Michael Hicks Beach made pointed reference to the claims made on the Treasury by the companies in question. How correct both of these statements were is shown by the position at this moment. How critical the state of affairs is in South Africa at present it is needless to say; and yet, just when most required, the cable from Delagoa Bay to Mozambique—the solitary cable—breaks down, and we must now rely for news of the most vital importance upon the long land line which runs through Natal to Cape Town. The broken cable was laid some 20 years ago, at the time of the Zulu war, in consideration of substantial aid given by the Government to the Eastern group, and, although the proprietary company has received since then State assistance amounting to considerably over £1,300,000, it appears that the clear duty of at least duplicating this cable has not been attended to, although this is the second occasion within the last six months on which this cable has broken. This case is an instance of one of the results arising from the State-aided monopoly. Sir Edward concluded by expressing the hope that all chambers in the Empire interested in the cheapening of rates would forward resolutions to Her Majesty's Government, so as to strengthen the hands of the House of Commons' Telegraph Tariff Reduction Committee.

Telegraphs in China.—The *Times* refers to an article in the St. Petersburg *Novosti* on the Russian posts and telegraphs in China. With regard to the telegraph, it is stated that that remains exclusively in the hands of the Chinese, save at Chuguchak and Kuldja. The Chinese system is connected with the submarine cable of the Great Northern Telegraph Company, which runs to Vladivostok and beyond, and also with the Russian land system at Blagovieshtchensk, Novokievsk, Sartakh, and Kiakhta. From the last-named

place the Chinese line runs at present only as far as Urga, the line from Urga to Kalgan, which is required to connect Kiakhta with Peking, not yet being completed. It is expected to be finished, however, in the course of the next few months, and then St. Petersburg will be in direct communication with Peking *viâ* Kiakhta. At present Russian telegraphic communication with Port Arthur has to pass over Chinese lines, but the Russian Post and Telegraph Department will shortly be able to use a wire placed on the telegraph posts of the Russian Eastern Chinese Railway, and then the all-Russia tariff will be charged for messages to Port Arthur and Dalny.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Corea-Japan	Aug. 7, 1899 ...	Aug. 19, 1899
Gibraltar-Tangier	Oct. 19, 1899 ...	Nov. 2, 1899
Havre-Waterville	Oct. 25, 1899 ...	...
Jamaica-Colon	June 30, 1899 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Tamui-Sharppeak	... ...	Nov. 7, 1899
Trinidad-Demerara (1871 original)	Oct. 20, 1899 ...	...
Do. do. (1891 duplicate)	Oct. 6, 1899 ...	...
Zanzibar-Mombasa	Oct. 27, 1899 ...	...
Lourenco Marques-Mozambique ...	Oct. 31, 1899 ...	...
Landlines.		
Colombian Government lines to Bogota	Oct. 31, 1899 ...	...
Communication with Mafeking ...	Oct. 13, 1899 ...	...
Communication with all offices beyond the Orange River ...	Oct. 18, 1899 ...	...
Communication beyond Burghersdorp, Cape of Good Hope, and Estcourt, Natal	Nov. 6, 1899 ...	
Communication with interior of Colombia, excepting Amalfi, Ambalema, Buga, Cartago, Ibague, Manizales, Medellin, Palmire, Pasto, Popoyans, Reinedos, Sonson, and Santo Domingo... ...	Nov. 6, 1899 ...	
Cuban Government lines	Oct. 30, 1899 ...	...
Lines from Haiti to Gros Morne and Port de Paix...	Aug. 18, 1899 ...	Nov, 7, 1899

Underground Telegraph Wires at Edinburgh.—At a sitting of the Railway and Canal Commissioners, held in Edinburgh on 31st ult., the Commissioners further considered the application on behalf of the Postmaster-General for the settlement of differences between the Postmaster-General and the Corporation of Edinburgh in connection with the laying of telegraph wires under the streets of the city. The Corporation, in their answers submitted, subject to their objection to any consent being given, that if consent were given it should only be under condition that the Postmaster-General should be bound in the option of the Corporation—

(1) To lay the wires under the directions and to the satisfaction of the defendants, and to pay defendants annually one-half of the sum received for use of the wires; or (2) to allow defendants within six months to lay the said wires at their own expense and as their own property, the Postmaster-General to pay an annual rent at the rate of 7 per cent. upon the cost of laying and renewal.

Mr. Colam, tramway engineer for the city of Edinburgh, said it was exceedingly impracticable to lay underground wires on the lines shown in the plan. Judging by their experience of the underground portions of South Bridge, he thought it would be a great pity if the Corporation allowed any more interference with that street. Mr. Gibson, the superintending engineer of the Post Office district in which Edinburgh is situated, was then called, and said he did not anticipate any particular difficulty in putting a pipe in South Bridge or any harm to the street. It was absolutely certain that from time to time the street would have to be cut because of the existing pipes. They selected the South Bridge because it was the most direct route, and one in which they had a pipe already. They did not consider the interests of the Corporation at all. At the close of the evidence the Dean of Faculty for the Corporation said the application was a round about one, as the service was to be obtained for the National Telephone Company for the Post Office to enable the Telephone Company to get into the streets without the consent of the Corporation. The Telephone Company were unable to get this application directly, and it was thus sought to obtain it indirectly. It would be a serious matter were the traffic of the streets disturbed, which the Corporation was bound to protect. The Corporation was the owner and was bound to repair, and therefore nothing could be laid on the bridges except with the consent of the Corporation. Lord Stormonth Darling here observed that in regard to narrow or crowded thoroughfares parties might have conferred in regard to deviation of route. The Lord Advocate, for the Postmaster-General, said he confessed the position he must assume must necessarily be to take up his lordship's decision in the Glasgow case. It seemed to him that what might be called the question of using the wire—not for proper Post Office service in the restricted sense, but for the purpose of the National Telephone Company—was absolutely settled by this Glasgow case. The question of physical impossibility in South Bridge might, he thought, be dismissed at once. There would be no great engineering difficulty. Judgment was reserved, Lord Stormonth Darling stating that if there were no alternative proposal laid before them of the South Bridge route within three weeks, they would take the case as it at present stood.

CONTRACTS OPEN AND CLOSED.

OPEN.

Accrington.—November 18th. The Corporation wants tenders for cables, wires, street boxes, and connections for electric lighting. See "Official Notices" November 3rd.

Battersea.—December 4th. The Vestry wants tenders for arc lamps and posts. See "Official Notices" this week.

Birkenhead.—November 14th. The Corporation wants tenders for 13 single-deck and 31 double-deck electric motor cars, also for boilers, economisers, mechanical stokers, steam dynamos, booster and battery. See "Official Notices" October 20th.

Birkenhead.—November 14th. The Corporation wants tenders for switchboard and instruments for the South End tramway generating station. See "Official Notices" October 27th.

Bray.—November 20th. The Council wants tenders for jet condensing plant for electricity works. See "Official Notices" November 3rd.

Bury-St.-Edmunds.—November 22nd. The Town Council invites tenders for electric light fittings for certain public buildings. Specifications, &c., at the Borough Surveyor's office, Town Hall.

Croydon.—November 13th. The Guardians want tenders for electric wiring and fitting at the workhouse, infirmary, and union offices. See "Official Notices" October 27th.

Darwen.—November 27th. The Corporation wants tenders for one Lancashire boiler and accessories, one tramway switchboard. See "Official Notices" this week.

Denmark.—December 28th. The Corporation of Aarhus is inviting tenders for the water-tube boiler plant, steam dynamos and switchboard, accumulators for electricity works. From our "Official Notices," November 3rd, further particulars may be obtained.

Essex.—November 27th. The Governors of Felsted School, Essex, are inviting tenders for boiler, two 27-kw. steam dynamos, condenser, pipework, accumulators, cables, and switchboard for electric lighting. See "Official Notices" October 27th.

France.—November 14th. Tenders are being invited by the French Post and Telegraph authorities in Paris for the supply of 10,000 metres of pipes 80 mm. diameter for pneumatic despatch tubes. Tenders to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Glasgow.—November 14th. The Corporation wants tenders for two 800-h.p. compound vertical auxiliary engines for the new tramway power station at Port Dundas. See "Official Notices" October 13th.

Glasgow.—November 20th. The Electricity Department wants offers for 10 miles of 2-inch cast-iron pipes. See "Official Notices" October 13th.

Greenock.—November 23rd. The Police Board is inviting offers for leasing the tramways within the burgh, and converting them into electric trolley lines. See "Official Notices" this week.

Hoylake and West Kirby.—November 15th. The Council is wanting tenders for Lancashire boilers, superheaters, economiser, steam engines, alternators, motor alternator, crane, wiring, steam, &c., piping, switchboards (high and low tension), batteries, transformers, concentric mains, &c., &c. See "Official Notices" October 13th.

Islington.—November 22nd. The Vestry wants tenders for condensing plant for the electricity works. See "Official Notices" November 3rd.

Lambeth.—December 6th. The Vestry is prepared to receive tenders for 25 arc lamps and posts. For particulars, see "Official Notices."

Leeds.—November 13th. The Corporation wants tenders for wiring, electric lamps, switches and fittings, for the Union Street Baths. See "Official Notices" November 3rd.

Middlesbrough.—November 22nd. The Electric Lighting Committee wants tenders for condensing plant and pipe-work for the electricity works. See "Official Notices" October 20th.

Mistretta (Sicily).—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Palermo, stating that tenders are invited by the Municipality of Mistretta, not later than December 31st next, for the establishment of a service of electric lighting in that town. Such particulars as have been received may be examined on personal application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

Newcastle-on-Tyne.—November 30th. The Tramways Committee wants tenders for two 1,000-h.p. steam dynamos for electric tramway works. See "Official Notices" October 27th.

Newington.—November 13th. The Vestry wants tenders for a 400-kw. steam dynamo and continuous current transformer for the electricity works. See "Official Notices" November 3rd.

North-Eastern Railway.—November 15th. The directors are prepared to receive tenders for the erection of a combined electric lighting and hydraulic pumping station, including chimney 120 feet high, at York. Plans and specifications on application to Mr. William Bell, the company's architect, at York.

Poplar.—November 16th. The Board of Works wants tenders for laying mains upon the solid system for three-wire continous current, viz., about 17 miles of five-core network, six miles of six-core feeders, also service cables and accessories. See "Official Notices" November 3rd.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

Portsmouth.—November 17th. The Council invites tenders for the supply of 40, 60, or 80 electric tramcars. See our "Official Notices" November 3rd.

Portugal.—November 22nd. Tenders are being invited, until 22nd inst., by the Royal Company of Portuguese Railways, for the supply of 8 tons of galvanised iron telegraph wire. Tenders to be sent to La Compagnie Royale des Chemins de Fer Portugais, Santa Apolonia. Particulars may be obtained from the offices of the company, 28, Rue de Chateaudun, Paris.

Spain.—November 23rd. Tenders are being invited until November 23rd by the municipal authorities of Chiclana de la Frontera (Cadiz province) for the concession for the electric lighting of the town during a period of five years. Tenders are to be sent to Le Secretariat del Ayuntamienti de Chiclana de la Frontera (Cadiz), whence particulars may be obtained.

Swansea.—November 20th. The Corporation wants tenders for five Lancashire boilers with jet condensing plant, feed pumps, economiser, piping, &c., for electricity works. See "Official Notices" November 3rd.

Wolverhampton.—November 13th. The Lighting Committee wants tenders for two 500-KW. direct coupled generating sets for the electricity works. See "Official Notices" November 3rd.

Wimbledon.—November 22nd. The District Council wants tenders for two 350-KW. steam alternators. See "Official Notices" this week.

Wrexham.—November 8th. The Council wants tenders for boiler house plant, engine house plant, dynamos, switchboard, mains, posts, battery, meters, crane, and buildings for electricity works. See "Official Notices" October 13th.

CLOSED.

Asylum Lighting.—The contract for the electric lighting of the North Riding of Yorkshire Lunatic Asylum at Clifton, York, has been given to Messrs. Crompton. Mr. A. A. Campbell Swinton is the consulting engineer, and the work will be carried out to his specification.

Blackburn.—The Corporation has placed orders with Messrs. Mavor & Coulson for two 260-KW. traction steam dynamos to the specification of Messrs. Lacey, Clirehugh & Sillar.

FORTHCOMING EVENTS.

Friday, November 10th.—At 5 p.m. Physical Society meeting in the Physical Laboratory of the Central Technical College, Exhibition Road, South Kensington (by kind invitation of Prof. Ayrton, F.R.S.) Agenda.—1. "Contact Electricity." By Mr. F. S. Spiers. 2. "On the Heat of Formation of Alloys." By Mr. J. B. Tayler.

Tuesday, November 14th.—Institution of Civil Engineers. "The Waterloo and City Railway," by H. H. Dalrymple-Hay, M.Inst.C.E.; "The Electrical Equipment of the Waterloo and City Railway," by B. M. Jenkin, Assoc.M.Inst.C.E.

Wednesday, November 15th.—Society of Arts opening meeting. Address by Sir J. Wolfe Barry.

Thursday, November 16th.—At 8 p.m. Institution of Electrical Engineers' opening meeting. Presentation of premiums and inaugural address, by President S. P. Thompson, F.R.S.

Newcastle-on-Tyne Association of Students (Institution of Civil Engineers), Durham College of Science, address by President J. H. Holmes, M.I.C.E., on "The Rise and Progress of Electrical Engineering."

Saturday, November 18th.—At 3.30 p.m. The Institution of Junior Engineers. Visit to the City and South London Railway Works, Stockwell.

Friday, November 24th.—Institution of Mechanical Engineers. Lord Chas. Beresford, C.B., M.P., on "Openings for Mechanical Engineers in China." President, Sir W. H. White.

Tuesday, November 28th.—Manchester Society of Junior Electrical Engineers. Meeting at Deansgate Hotel, Manchester. Paper by Mr. J. H. Henderson on "Aluminium, Its Treatment and Use, as Applied to Electrical Engineering."

Wednesday, December 6th.—Institution of Electrical Engineers' annual dinner, Grand Hall, Hotel Cecil.

NOTES.

Consulting Engineer or Tradesman?—Editors find it necessary to rule that anonymous letters shall not be published, but sometimes it becomes desirable to make an exception to prove its existence. A correspondent who dubs himself "Consulting Engineer," but fails to disclose his name and address, sends us the following communication, which we publish, because it is upon a question of general interest at the moment:—

"I am much interested in the correspondence which appears in this week's issue between a 'Consulting Engineer' and a firm of contractors.

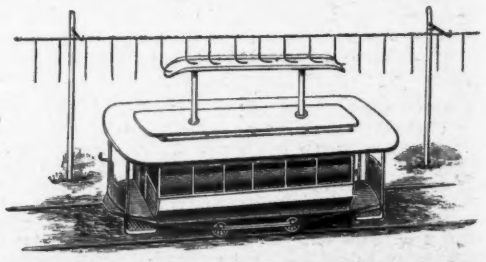
"Provided that these descriptions are accurate, I quite agree with the position taken up by the contractor, but, at the same time, it is quite possible that the 'Consulting Engineer' was one of these numerous tradesmen who also act in dual capacity of 'Consulting Engineer' and Contractor, and openly advertise themselves as such.

"Whether it be the case of the 'Consulting Engineer' acting as the contractor, or of the contractor acting as the 'Consulting Engineer,' both positions are equally illogical and indefensible, and I am inclined to think, judging from the headings of letters that I receive, that the latter class is a very numerous one, and I do not think it would be unreasonable to ask our Institution to take steps to define the respective spheres.

"They alone can do it, and until this is done clearly, the gentleman who acts in the dual capacity, derives considerable benefit from the pecuniary point of view, whatever the moral aspect of the case may be. It appears to us the first essential of a 'Consulting Engineer' is that he should have no trade interest.

"At the same time, I should like to remind your correspondent that while no consulting engineer is entitled to trade prices except for his own personal use, he is, nevertheless, entitled to know what the trade discounts are, for I confess that I personally could never draw my estimates without this information, so long as manufacturers adhere to the practice of giving different trade discounts, varying from 5 per cent. to 75 per cent., according to the class of article required.—A CONSULTING ENGINEER."

An Insulated Trolley Line.—The *Street Railway Review* says: "Among the startling inventions which appear from time in the electric railway field comes one from Ft. Myers, Fla., in the shape of an insulated trolley wire, which, according to its inventor, Capt. W. O. Rew, possesses manifold merits of the highest order, and which has elicited



the most flattering comment on the part of electrical engineers and street railway men wherever the model illustrated herewith has been submitted to expert criticism. On the top of the car is a metal trough making contact with pendant wires from the overhead line. The pendant wires are to be insulated to within a few inches of the lower end."

The Ashton Dynamos.—We reprint from the *Ashton-under-Lyne Reporter* the following letter from Messrs. Lacey, Clirehugh & Sillar, consulting engineers to the Ashton Corporation :—

ASHTON ELECTRICAL WORKS.—THE DYNAMOS.

SIR,—We understand that an impression exists in the minds of some that the dynamos which have been installed by the Ashton Corporation for generating electricity for the purpose of supplying light and power both to the town and the Oldham, Ashton, and Hyde Electric Tramways are not satisfactory. In justice, therefore, to the manufacturers, Messrs. P. R. Jackson & Co., we think it only fair, as consulting engineers to the Corporation, to make the actual facts public. Three dynamos are at work, each of which should be capable of giving 500 B.H.P., and it is a condition in the specification that each machine, before being fically accepted, should be tested at full load for six hours, and that at the end of that period no accessible part of the dynamo should have a temperature higher than 70° F. above that of the surrounding atmosphere. The first dynamo tested complied with the specification in every way, but the armatures of the remaining two heated above the specified limit. Messrs. Jackson, on being notified of this, at once admitted the error and offered to rectify it, and this is at present being done. The fault has in no way militated against their use, as they have been in daily service on the tramways and lighting ever since. There are several features in the dynamos which are quite new, and have enabled results to be obtained which, as far as we are aware, have never been approached before. When it is remembered that the Ashton Corporation are the first who ever supplied power for tramway and lighting purposes simultaneously from the same machine, and that there has never been any intermission in supply since the opening of the works, we think you will understand how unfair it is to attach blame to the manufacturers, whom we consider worthy of a considerable amount of credit. We would also point out that the total capital expenditure on the works is the lowest per horse-power installed that has ever been known in this country, and in addition, the whole of the material employed is of the highest quality, also that the Ashton Corporation are the first municipality to undertake the supply of power to a tramway company, from which source a large revenue is already coming in.

From the above, you will see that there are so many novel features in the works, that it could hardly be expected that everything would immediately work perfectly; but there is no doubt that if properly managed, the works will be a source of very great profit to the town.

We are, yours faithfully,
LACEY, CLIREHUGH & SILLAR.

78, King Street, Manchester,
November 2nd, 1899.

Appointments Vacant.—The District Council wants an assistant engineer for the electricity works. See "Official Notices."

The Corporation of Aberdeen wants a mains engineer at a salary of £117 per annum. See "Official Notices."

The Huddersfield Corporation wants an electrician-in-charge, at a salary of £2 per week. See "Official Notices" this week.

The City and South London Railway Company wants two assistants to take charge of an accumulator sub-station. See "Official Notices."

Cable Interruptions.—Mr. F. C. C. Neilsen, the representative in England of the Great Northern Telegraph Company, Limited, writes as follows :—"I observe that in the table of interruptions in the last number of the ELECTRICAL REVIEW, the Corea-Japan cable appears as having been interrupted since August 7th last. Permit we to point out that this cable was repaired on August 19th, and that the restoration was duly notified by Berne, telegraphically on August 20th, and in Notification No. 501 on September 1st."

Re Thawing Pipes by Electricity.—As we go to press Messrs. Drake & Gorham write as follows :—"We notice your extract from the *Canadian Engineer*, and can bear out your statement that it would be too much to expect the London water companies to bring out such a modern method. We have what we believe to be the patent for this application of electricity, No. 1,315, January 21st, 1893, and although our experiments show that mains laid too near the surface could, when frozen, be put into working order without the necessity for breaking the roads, we were unable to get the water companies to take an interest in the invention. It should be pointed out that it is not necessary to thaw all the ice in the pipe, but merely that immediately in contact with the wire, so as to make a small passage through which the water under pressure can flow. It will then be found that the water itself soon does the rest."

Personal.—We understand that Mr. W. J. Milne Menzies is about to sever his connection with the Consolidated Telephone Construction and Manufacturing Company. Mr. Menzies' long term of service with this company—15 years—is a guarantee of a wide knowledge of the telephone manufacturing business, and it goes without saying that in the course of his experience he has been brought into touch with some of the best buyers (railway companies and Government departments), which cannot fail to stand him in good stead, whatever may be his sphere of future operations.

Some days ago the employés of the National Conduit and Cable Company, New York and London, presented Mr. W. H. Murphy, Mr. Regan's (superintendent) principal assistant, with a handsome gold watch and chain. He had made himself very popular with the officials of the Dublin United Tramway Company, for whom the company have laid the electric cable. The chairman complimented Mr. Murphy upon having gained the good opinion of one and all, and he trusted he would assist his chief in making Glasgow, where they were going, what they had made Dublin, one of the best equipped electric tramway cities in the world.

The Hastings Electric Lighting Committee have appointed Mr. C. S. Pasley (formerly one of the assistants at the Westminster Electric Supply Company's Works) to fill the vacancy of assistant engineer at the Hastings electricity works. There were 67 applications.

Mr. Robert Birkett has been appointed borough electrical engineer at Burnley in succession to Mr. R. Wright, who goes to Bootle.

Mr. S. E. Britton, chief assistant at the Southampton electricity works, has been appointed resident electrical engineer at Barking. His friends at Southampton have presented him with a handsome tantalus as a token of their esteem.

Mr. A. Nichols-Moore, of the City of Hull Corporation tramways, has been appointed engineer-in-chief on the staff of the Blackpool and Fleetwood Tramroad Company.

We hear that Mr. C. H. Wheeler, president of the Wheeler Condenser and Engineering Company, of New York and London, has arrived in London. The above firm have a large number of contracts covering their cooling tower and condensing plant under way at the present time.

Lectures.—The Technical Instruction Committee of the West Riding County Council are making arrangements for an exhibition, representative of technical and secondary education, to be held at Leeds in December. The Committee are also arranging for Prof. Oliver Lodge to give a short course of lectures after Christmas at some convenient centre, on "Electrical Vibrations."

At a meeting of the Municipal Technical School Engineering Society at Birmingham last week, Mr. R. Hornby read a paper on "Electricity Meters." Commencing with an historical review of the development of electricity meters, the lecturer proceeded to describe the Edison, Edmondson, Forbes, Thompson, and Hookham meters. The lecture was illustrated by specially prepared lantern slides.

The first meeting of the Liverpool Engineering Society for the present session was held on 1st inst. at the Royal Institution, Liverpool. The inaugural address was delivered by Mr. A. Bromley Holmes, M.Inst.C.E., president, who gave a historical sketch of the progress of electric appliances throughout the century, dealing at some length with the question of electric traction.

Marconi to the Front!—Yesterday's *Star* says that Laffan's New York agent telegraphs as follows :—"Signor Marconi states that he has sold all his patent rights in America, it is reported, for a million dollars and a large royalty. His assistants have started for South Africa; he, himself, will soon follow."

The correspondent of the *Daily Telegraph* quotes Mr. Marconi as saying : "He would like to go to the front himself, but the directors of his company seemed to think he might be killed."

Society of Engineers.—Before this Society on Monday, Mr. Sherard Cowper-Coles read a paper on "The Electrolytic Treatment of Complex Sulphide Ores."

Foreign Competition.—An esteemed contemporary has taken up this question, and, in response to a leading article, has received some correspondence. Mr. Bailey, of the City Electric Light station at Bankside, has had some useful experience of delay in getting goods. Mr. Bailey has never in 10 years known one instance where a guarantee of punctuality has been carried out. He gives actual dates. He also points out that the cause of delay is attributed to want of raw material. We know that lack of strip is a common excuse with the maker of lap-welded tubes. Generally he sums up that the credit of our home industries is jeopardised by the restricted and unsatisfactory output of iron and steel makers. Mr. Wordingham also writes and shows how he has been driven to purchase American—very properly Mr. Wordingham declines to use the word "foreign" in referring to America—machinery by reason of the ridiculous delay of home firms. At the same time, another writer complains that home firms have not been allowed to tender on standard plant, though standard plant has been accepted from America. He also girds at the London County Council, who have led the way in sending work to be done in Europe by sweated workmen without asking questions, and have demanded stringent and foolish conditions from home firms on pseudo-Socialistic lines. This writer does not fear American competition as likely to be soon planted in our midst, as he anticipates they will have as much trouble with trades unions as have home firms. Just at present, however, we do not know that militant trades unionism is giving much trouble. Mr. Barnes is, for the moment at least, fairly crying out for what employers wished in 1897, and for the moment we think employers are to blame for delays. They certainly appear to be infatuated with the present profitable state of business, and to be neglecting the future. They are, in fact, doing business of such a profitable order, that they seem blind to all else, and we fear they are in many cases practically inviting competition from abroad by, to say the least, the *brusquerie* of their present tone in dealing with customers. If orders are to go abroad at all, by all means let America be preferred. The attitude of the European press at the moment should alone entitle us to prefer our trans-Atlantic friends.

The Charing Cross Company and the City Supply.—At the Court of Common Council last week, the Streets Committee recommended the application of the Charing Cross and Strand Electricity Supply Company, for approval of a site at Marsh Gate Lane, Bow, as a generating station, subject to the Corporation in any purchase which it might make not being compelled to pay more than £2,250 an acre for the whole 7½ acres, and to the plans for the erection being approved. The Court approved of the site, and also empowered the same company to lay mains, &c., on the south side of Fleet Street, and a portion of Fetter Lane. The Court also decided to inform the City of London Electric Lighting Company that their means of testing the public and private supply was not satisfactory.

Sweet are the uses of Advertisement!—We reprint the following from the advertisement pages of the *Municipal Journal and London* for November 3rd, 1899, without comment :—

THE FUTURE OF THE TELEPHONE

Local Authorities and others interested in the Development of

LOCAL TELEPHONE EXCHANGES

Can obtain information on the Legal, Engineering, and Commercial aspects of the question from

MAJOR-GENERAL C. E. WEBBER, a Past President of the Institute Electrical Engineers, and a Consulting Telephone Engineer.

27, CHANCERY LANE, LONDON, W.C.

The Lawton Gas Engine.—It appears that Messrs. Lawton & Parker, of Manchester, make a gas engine of ¼ H.P. This is illustrated in the *Engineering Times*, and is a simple-looking machine that is said to be largely sold, and it is claimed to be capable of driving a dynamo for 10 16-C.P. incandescents, and to be a well-made machine. No particulars are given as to its dimensions or speed.

Society of Arts.—The following are among the arrangements for the 1899-1900 session :—

November 15th.—Opening address of Sir John Wolfe Barry, K.C.B., V.P.Inst.C.E., F.R.S., chairman of council.

Papers for meetings after Christmas :—

"Electric Traction." Charles H. Gadsby.

"Steam Motors for Common Roads." By John I. Thornycroft.

"A National Repository of Science and Art." By Prof. W. M. Flinders Petrie, D.C.L.

"The Electrical Induction Motor on Mountain Railways." By Prof. Charles A. Carus-Wilson, M.A.

Major Philip Cardew, R.E., "The Control, Regulation, and Measurement of the Supply of Electrical Energy." Three lectures. May 7th, 14th, 21st.

Two lectures, suitable for a juvenile audience, will be delivered on Wednesday evenings, January 3rd and 10th, at 7 o'clock, by Mr. Herbert Jackson, on "The Phenomena of Phosphorescence."

The Institution of Civil Engineers.—Next Tuesday's meeting will be devoted to the papers on the Waterloo and City Electric Railway. At subsequent meetings the following papers will be submitted for discussion :—

"The Purification of Water after its Use in Manufactories." By R. A. Tatton, M.Inst.C.E.

"Combined Refuse Destructors and Power Plants." By C. Newton Russell, Assoc.M.Inst.C.E.

"The Treatment of Waste Water from Factories." By W. O. E. Meade-King, M.Inst.C.E.

Tunbridge Wells.—On Wednesday, the members of the Lighting Committee were entertained at luncheon at the Calverley Hotel, by the chairman, Mr. E. Elvy Robb, for the purpose of meeting Sir William H. Preece, on the occasion of his visit to the Corporation electricity works. The company included several prominent townsmen, and some representatives of the London technical and local press. Several important speeches followed the luncheon, in which references were made to the probable introduction of municipal electric tramways, dust destructors, and telephones, but we must reserve our comments upon these till next week.

Electrical Supplies for United States Fortifications.—The United States Secretary of War has appointed a board of officers, consisting of Lieutenant-Colonel Alexander Mackenzie, Corps of Engineers; Major M. C. Martin, Quartermaster's Department; Major James Allen, Signal Corps; Captain William Crozier, Ordnance Department, and Captain J. R. Williams, Seventh United States Artillery, to meet at the War Department at the call of the president of the board, to make recommendations concerning the proper source of supply, by the staff departments, of all electrical appliances and apparatus in use at fortifications and the materials and accessories relating thereto, with the view of furnishing uniform types and providing for the control, responsibility and efficiency of the apparatus. The *Western Electrician* says that other subjects to be considered are the proper means by which repairs to guns and gun carriages at fortifications shall be made, and by which department the necessary tools and appliances for such purpose shall be furnished; the qualifications of electrician sergeants and the character and scope of examinations for their appointment, and the proper source of supply by the staff departments of the tools and implements required for the use of the battery mechanics for each heavy battery of artillery.

Turning the Tables.—We have often gathered from quack advertisements that diabetes could be marvellously cured by the aid of electricity. Whatever may have been our doubts thus far as to the genuineness of such claims, they cannot now fail to be dispelled in presence of the following American story. We give full and ungrudging credit to the *Western Electrician* for this tall tale :—

George Darling, of the O. B. Cook Company, fell off a Citizens' electric car when it was going a 12 mile gait and landed on his head. He had the diabetes for two years previous to the accident, but is now pronounced cured. Dr. Obetz says that he was cured by the shock. Darling had thought of suing the street railway company for damages, but it is now reported that the officers of that corporation are considering the commencement of a proceeding against him to recover an adequate amount of fees for expert treatment.

Improved Trolley Poles.—The following comes to hand as we go to press:—"You have overcome one difficulty in the working of this trolley pole, for your correspondent 'W. H. S.' Can you suggest how the inventor proposes to raise the pole when perchance it leaves the wire? —R. W. T."

[We regret that we do not know the inventor's intentions in this respect, but probably a light bamboo rod with a forked end would answer the purpose.—Eds. Elec. Rev.]

Army Reserve Men.—The employés of the Arc Works, Chelmsford, of Messrs. Crompton & Co., Limited, have resolved to contribute 1d. per week each to a voluntary fund for the wives and children of soldiers taking part in the South African war. The movement was set on foot by the Arc Works Sick Benefit Society.

NEW COMPANIES REGISTERED.

Thanet Constructional Company, Limited (64,065).—This company was registered on November 3rd, with a capital of £300,000 in £10 shares, to adopt an agreement with the Isle of Thanet Electric Tramways and Lighting Company, Limited, and an agreement with William M. Murphy, to construct, maintain, and work light or other railways and tramways, electric lighting and power and other undertakings in the Isle of Thanet, Kent, and to carry on the business of electricians, engineers, contractors, omnibus, van, motor, and rolling stock manufacturers and dealers, &c. The subscribers are:—W. M. Murphy, 39, Dame Street, Dublin, with 11,997 shares; H. R. Pecton, 6A, Austin Friars, E.C., with 6,000 shares; British Thomson-Houston Company, Limited, 83, Cannon Street, E.C., with 4,000 shares; V. A. Waldron, 10, Anglesea Street, Dublin, stock broker, with 6,000 shares; E. A. Lazarus, 52, Threadneedle Street, E.C., bank manager, with 2,000 shares; J. J. O. Connor, 27, Lower Sackville Street, Dublin, drapery manager, with 1 share; J. F. Murphy, Dartry, Upper Rathmines, Dublin, barrister, with 1 share; W. H. Briggs, 39, Dame Street, Dublin, civil engineer, with 1 share. The number of directors is not to be less than three nor more than seven; the first are to be appointed by the subscribers; qualification, £500; remuneration, £200 each per annum.

Tramway Traction Company of South America, Limited (64,076).—This company was registered on November 4th, with a capital of £60,007 in 200 shares of £250 each, and seven shares of £1 each, to adopt an agreement with Albert W. Rosy, Annibal Falcao, and Charles Georgi, to promote, conduct, or manage any commercial, financial, mining, electrical, and industrial undertakings, and to carry on the business of tramway and railway contractors, and suppliers of electricity and other power. The first subscribers (each with one share) are:—P. B. Potter, Ravensleigh, Water Lane, Brixton, clerk; A. C. Downing, 8, Victoria Gardens, Notting Hill Gate, W., clerk; P. J. Hellis, 1, Merthyr Terrace, Castlenau, Barnes, S.W., clerk; W. H. Thompson, 8, Dalebury Road, Upper Tooting, S.W., gentleman; E. Puchard, Richmore, Hampton Wick, gentleman; E. Cadett, 84, Grove Lane, Denmark Hill, S.E., gentleman; and F. Durant, 114, Tachbrook Street, S.W., clerk. Registered without articles of association.

CITY NOTES.

Eastern Extension, Australasia, and China Telegraph Company.

The half-yearly meeting of this company was held at Winchester House on Wednesday, the Marquis of Tweeddale presiding.

The Chairman said that the report for the half-year ended June 30th would be deemed highly satisfactory. The gross revenue had amounted to £324,361, which was an increase of £47,079 on the corresponding half-year. The result was due to increased traffic all over the company's system, but more especially owing to the increase of traffic from China and Manila. The working and other expenses had amounted to £107,266, or an increase of £4,293. This was partly accounted for by the opening of new offices in the Philippines, accompanied by the greater number of staff for dealing with the increasing traffic. The usual dividends of 5s. per annum had been paid for the half-year, and after transferring £5,000 to a special reserve fund in connection with the now proceeding removal of the head offices, and £100,000 to the general reserve fund, they carried forward £13,279. During the period under review the general reserve fund had been debited with £68,901 in connection with the renewal work to the Saigon-Hong Kong cable, the extension of the Manila-Pansy cable to Iloilo, and the laying of a direct cable between Iloilo and Cebu. Unfortunately, the political situation in the Philippines showed no improvement, and it seemed that further heavy fighting must ensue before American rule could be firmly established. He hoped that before the next meeting a more satisfactory state of things would prevail there. Shortly after he addressed the last meeting, H.M. Government decided to co-operate with certain Australian and Canadian Governments in the laying of a State cable across the Pacific Ocean. The directors of this company, and of the Eastern Company, protested against the Government entering into competition with private enterprise, and pledging the credit of the country for such a purpose, more particularly as the company had proposed to lay a cable through what was an admittedly better strategic and commercial route to the Cape, and on terms more advantageous to the Governments concerned. A deputation waited upon the Chancellor of the Exchequer to express grave objection to so serious an attack upon private interests, and the remarks addressed to them made it clear that the Government was not disposed to withdraw from its promise to assist the Colonies in the manner indicated. At the same time it expressed the opinion that the loss to the company would not be so large as seemed to be anticipated, and further, that there was no intention whatever of competing with the company on other than fair and equitable terms. After careful consideration of the situation so created, the directors came to the conclusion that the interests of the company would be best served by at once offering to meet the often-expressed desire of the Australian Colonies for an alternative cable route, and a reduced tariff. They accordingly submitted a proposal for extending the new Cape cable to Australia without requiring any subsidy from the Australian Governments and at once decreasing the tariff to 4s. a word, to be followed by further reductions on a sliding scale down to 2s. 6d. per word as the traffic responded to the reductions. The only condition attached to that proposal was that the company should have the same freedom of dealing with the Australian public as prevails in this country and elsewhere. Without such freedom the company would be entirely dependent upon the Governments for the collection, transmission, and delivery in Australia of the traffic, making it impossible for them to carry on their business on equal terms with their competitors. That proposal had been very favourably received by the Press, Chambers of Commerce, and mercantile communities generally in Australia, and they had reason to believe that it would be eventually accepted. The moment they received satisfactory assurances on that point the laying of the cable from the Cape to Australia would be proceeded with without delay. With regard to the Pacific project, they would remember that the Imperial Government decided to limit their subsidy payment to £20,000 per annum, but that decision caused some dissatisfaction in Australia and Canada. The Government therefore reconsidered their offer, and they are now prepared to take part in the working, management, &c., of the cable. An advisory board representing the Government and the Australian and Canadian colonies had been, or would immediately be, appointed for the purpose. That cable when laid in two or three years would divert some of the company's traffic—that was self-evident; but still they might, with their two independent cables and access to their own offices in the principal Australian towns, look forward to the coming competition, when it came, without any serious or great apprehension. They would observe from the report that it was proposed to alter the trust deeds of the staff pension and superannuation funds so as to admit of the retiring age being altered to 55 years instead of 60. That change was very desirable, inasmuch as they found the existing age limit too high, and tending rather to the retention of employés who were no longer able to give efficient service. To do this, the company's contribution to the pension fund would have to be increased from 2½ per cent. to 4 per cent. The sum required from the company to make up the back payment was, roundly, about £11,000, and if the amount were spread over 20 years, as was proposed, it would only represent a few hundred pounds per annum in addition to the increased contribution. The Marquis of Tweeddale then moved the adoption of the report.

Mr. F. A. Bevan seconded the motion, which was carried unanimously.

The necessary resolution for effecting the alteration in the pension fund trust deed having been passed, a few remarks were offered by shareholders, and in reply,

The Chairman said that by the change in the pension age limit it was not meant that they would compulsorily retire all officials at 55, but only where there might be inefficiency due to age. He had read Sir Edward Sassoon's speech to the Folkestone Chamber of Commerce. He made the old charge against this company of monopoly. He (the hon. marquis) had to meet this when he addressed the Chancellor of the Exchequer, and he pointed out that they had no monopoly at all between this country and Australia or India. There were various routes, and the word monopoly did not apply to them in any degree whatever. The Government were going to lay a cable, which they could not have done if the company had enjoyed a monopoly. In reference to the statement about interruption to the cables, he pointed out that there was only one cable interrupted, viz., the East Coast cable; the West Coast cable was working as well as it possibly could do. With regard to the East Coast, everything had been done that could be done to ensure its speedy repair. They had no fewer than three cable repairing ships on the East Coast, distributed over the coast ready to repair any fault. He confessed they were not a little disappointed that that particular fault in the Mozambique cable had not been repaired by this time. There was no interruption between this country and the Cape so far as telegraphic communication was concerned. It was impossible to prevent interruptions taking place, they arose from a variety of causes, artificial and natural. If the Government had only listened to the directors two years ago, they would have had a third cable now working to the Cape. It was not the company's fault that there were not now three. They were laying it now, having recently got approval and permission to land. The new cable would be on the West Coast of Africa.

A Shareholder asked what would be the cost of extending the cable from the Cape to Australia, and whether it would be provided from reserve or the issue of capital.

In reply, the Chairman said that the cost of the cable would be borne partly by the Eastern and partly by this company. The share of the Eastern Company would be something like £1,000,000.

A vote of thanks to the chairman, directors, and staff brought the meeting to a close.

The West India and Panama Telegraph Company, Limited.

The directors' report for the half-year ended June 30th, to be submitted to the meeting on 15th inst., reads:—

"The directors submit the accounts for the six months ended June 30th, 1899. The amount to credit of revenue is £30,929 10s. 8d., against £39,612 14s. 2d. for the corresponding half-year of 1898, and the expenses have been £21,492 4s. 8d., against £21,704 17s. 5d., leaving a balance of £9,437 6s., which, with £4,920 0s. 8d. brought from last account, makes a total of £14,357 6s. 8d., with which it is proposed to deal as follows:—

	£ s. d.
First preference shares—	
Dividend, six months to June 30th, 6s. per share.. ..	10,968 18 0
Second preference shares—	
Dividend, six months to June 30th, 6s. per share.. ..	1,400 14 0
Ordinary shares—	
6d. per share (free of income-tax)	2,208 0 6
Balance to current half-year's account	379 14 2
	£14,357 6 8

"The total receipts show a decrease of £8,683 3s. 6d., as compared with the corresponding period of 1898, when they were abnormally large consequent on the Spanish-American war. The expenses of repairing cables during the half-year amounted to £8,334 8s. 3d., being £572 15s. 1d. less than those for the corresponding period. The St. Lucia-St. Vincent cable which was interrupted by the hurricane of September last year has been finally restored. The cost of renewing the original part of this section, amounting to £2,616 8s. 4d., has been charged to reserve. In August last another disastrous hurricane passed over some of the West India islands, causing great loss of life, and much distress followed. The directors, feeling sure that their action would meet with the approval of the shareholders, forwarded a donation of £100 to the Lord Mayor's relief fund. Telegrams relating to the hurricane and distress fund were transmitted free of charge as on the previous occasion. The Jamaica-San Juan (Porto Rico) cable was interrupted by this hurricane, which also damaged some of the company's landlines, all of which have since been repaired. A contract has been entered into for the manufacture and delivery in the West Indies of 310 knots of cable for stock. The directors are pleased to report that the Danish colonies of St. Thomas and St. Croix have renewed their subsidies for a further term of five years."

Prospectus.

On Wednesday the list of applications closed of an issue of £125,000 4½ per cent. perpetual second debenture stock of the Brush Electrical Engineering Company. This issue has been made in order to redeem the outstanding £50,000 4½ per cent. redeemable second debenture stock, to pay off bank loans, and to provide for further extensions to the Loughborough works. £75,000 has just been offered at £105 per cent., the balance being reserved in order that holders of the existing £50,000 4½ per cent. redeemable second debentures may have the option of exchanging same for the present issue of stock at par.

Improved Electric Glow Lamp Company.—A meeting of this company was held at Cannon Street Hotel yesterday (Thursday) morning, but our representative was refused admission.

Personal.—Mr. Charles S. Drummond has been appointed a director of the British Electric Traction Company.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending November 4th, 1899, were £189 7s. 11d.; November 4th, 1898, £192 4s. 1d.; aggregate for half-year to date, £19,061 3s. 8d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending November 3rd, 1899, were £3,139 17s. 8d.; corresponding period, 1898, £2,566 9s. 6d.; increase, £572 18s. 2d.

The City and South London Railway Company.—The receipts for the week ending November 5th, 1899, were £1,045; November 6th, 1898, £1,027; increase, £18. Total receipts for half-year, 1899, £18,823; total receipts corresponding period, 1898, £18,802; increase, £21. Miles open, 8¼.

The Dover Corporation Electric Tramways.—The receipts for the week ending October 28th, 1899, were £179 19s. 10d.; October 29th, 1898, £190 9s. 5d.; decrease, £10 9s. 7d. Total receipts to date, 1899, £8,643 3s. 11d.; corresponding period 1898, £7,174 19s. 1d.; increase, £1,468 4s. 10d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,794, 1898, 4,413. Number of cars, 1899, 11; 1898, 11. The receipts for the week ending November 4th, 1899, were £175 13s. 11d.; November 4th, 1898, £165 6s. 5d.; increase, £10 7s. 6d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,755; 1898, 4,208. Number of cars, 1899, 11; 1898, 11. Total receipts to date, 1899, £8,818 17s. 10d.; corresponding period, 1898, £7,340 5s. 6d.; increase, £1,478 12s. 4d.

The Dublin United Tramways Company.—The receipts for the week ending Friday, November 3rd, 1899, were as follows:—D. U. T. Co., horse cars, £908 17s. 3d.; ditto, electric cars, £2,670 5s. 11d.; D. S. D. Co., electric cars, £693 8s. 6d.; total, £3,671 11s. 8d.; corresponding week last year.—D. U. T. Co., horse cars, £2,393 17s. 9d.; ditto, electric cars, £384 18s. 1d.; D. S. D. Co., electric cars, £735 16s. 4d.; total, £3,363 12s. 2d.; increase, £307 19s. 3d. Aggregate to date, £78,275 3s. 6d.; aggregate to date last year, £75,473 19s. 9d.; increase to date, £2,801 2s. 9d. Worked.—The mileage open is 37 miles electrically, 7 miles by horses, as against 13 miles electrically, and 29 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending November 5th, 1899, were £601 November 9th, 1898, £284; Car miles run, 12,088; 1898, 8,584. Number of cars, 1899, 28; 1898, 10. Total receipts to date, from April 1st, 1899, £18,893; 1898, from June 29th, 1898, £5,175. Miles of track open, 12; 1898, 2¼.

The Liverpool Overhead Railway Company.—The receipts for the week ending November 5th, 1899, amounted to £1,873; corresponding week last year, £1,451; increase, £422.

The South Staffordshire Tramways Company.—The receipts for week ending October 3rd, 1899, were £696 19s. 9d.; November 4th, 1898, £662 13s. 0d.; aggregate receipts for 44 weeks, £29,355 7s. 9d.; 1898, £27,886 16s. 6d.

STOCKS AND SHARES.

Wednesday Evening.

It is a pleasure to be able at last to report that signs are apparent of a distinctly better time for electrical shares in the near future. This is, of course, the season when supply shares, in particular, come into favour. The investing public refuses steadfastly to look at anything in the nature of an electric lighting concern in the summer time; consequently, prices sag. Besides this reason, there has been a concatenation of other circumstances to keep quotations flat; politics and dearer money being the two chief causes. Now, however, a feeling of confidence is beginning to creep round the market, in spite of the hardening of discount rates, caused by the Treasury Bills emission. Electric lighting descriptions are being freely dealt in again, and Citys were the first to respond to the more active tone. The winter is at hand, when the company may reasonably look for better receipts, on account of the additional users it has secured during the summer months. Competition by the Charing Cross Company is still far off, and the passing of the last dividend has, it is supposed, put the City Company into a strong financial position. While the outlook for the future is still hazy, and no one can foresee what may be the result of the reduction of rates, the shares are distinctly a speculative investment.

St. James's and Pall Mall mark another advance, the new issue being safely disposed of by now. Westminsters are hard, and the next rise seems most likely to occur in shares of this steady investment type, for the amount of public money lying dormant is tremendous, and people will not for ever be satisfied at getting the miserable rate of interest that a bank allows upon deposit accounts.

No attempt has been made to start a market in the new Alliance Electrical Preference shares. The amount of the public issue being so trifling, there can never be anything approaching a free market in them, and the investment is coldly regarded for this reason. The Stock Exchange always dislikes a security—however good—in which dealing has to be a matter of negotiation.

Telegraph securities have brightened generally, and Eastern Ordinary has again scored. "The public wouldn't look at the stock when it was flat," exclaimed a jobber in the market, "but now that it is rising, see how they come for it!" Extensions have also hardened, but shareholders are beginning to grumble as much as the newspapers at the rigour exercised by the press censor at the theatre of war. He is lessening their chances of a good dividend, they pathetically say. Anglo-American issues are better, the Deferred stock regaining favour as a gambling counter, and the Preferred coming into demand from investors who must have a 5 per cent. return with as little risk as possible. Moreover, the Yankee Railway Market continues exceedingly strong—always a good omen for bulls of Anglo Telegraphs. Globe Ordinary have appreciated a trifle, but the Preference can be bought at 15⅞, or a shade less, and Submarine Cables Trust are up 1, but West India and Panama shares have been sold and are ½ down, it being feared that the recent hurricanes have done more serious damage than was at first reported.

National Telephones shed a small fraction as the result of the decision arrived at by the Glasgow Corporation with regard to wayleaves. The reason for the fall seems distinctly trivial, and there are some who say that its effect should have been to enhance instead of decrease the value of National Telephone shares.

Very little has to be said about the more miscellaneous varieties. British Electric Traction Pref. are a thought weaker, but no change has taken place in the Ordinary. New General Tractions are 4 and Potteries Ordinary 13¾.

Henleys are still denied a quotation in the Official List, but this is likely to be remedied shortly. The Ordinary are 12⅞ to 13⅜, and the Preference 5⅞—⅝.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Oct. 31st.	Closing Quotation, Nov. 8th.	Business done during week ended Nov. 8th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	65 — 68	65 — 68	68½	66
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	116½—117½	116½—117½	116¾	116½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	16½— 17	17 — 17½	17½	16 15/16
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15⅝	15⅛
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	180 —190	180 —190	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	103 —105	103 —105	104	103½
234,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20 xd	19 — 20 xd	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½%	3½%	11⅜— 12¼	12 — 12½	12	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	156 —161	157 —162	161	158
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	99 —102	100½	99
89,900	Do. 5 % Debs., repayable August, 1899	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	117 —122 xd	117 —122 xd	120½	118
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	15 — 15½	15½— 16	16	15 5/16
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	118 —123	118 —123	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	101—104% xd	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5½%	11 — 11¼xd	11⅛— 11⅜	11⅜	11¼
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15½— 16 xd	15½— 16	15⅝	15⅜
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 31	30 — 31	30⅛	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52 xd	48 — 52 xd	48½	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	106¾	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000	1	...	...	...	⅛— ¼xd	⅛— ¼	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	⅜— 1 xd	⅜— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	5⅛— 5⅜	5 — 5¼	5 3/16	5
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13½ — 14½	14 — 15	14½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13½ — 14½	14 — 15	14⅜	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5½	5½	5⅜
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —102	100 —102	101	100⅜
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅜— 1 xd	⅜— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	128 —133	129 —134	132	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	...	...
151,733£	Do. do. 5 % Debs.	Stock	...	..	...	105 —108	105 —108	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —102	99 —102	100	...
80,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red.	Stock	...	...	...	104 —107	104 —107	104½	...
88,321	West India and Panama Telegraph	10	1 %	1%	...	1½— 1⅝	1½— 1⅝	1⅝	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	10⅝	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	8½— 9½	9 — 10	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	104 —107	105 —108	106	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7½— 8½	7½— 8½	...	...
12,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	...	9 — 10	9 — 10	...	...
80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	9½ — 10½	9½ — 10½	10½	...
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	6⅝	...
34,000	*Chelsea Electricity Supply, Ord.,	5	5 %	6 %	6 %	8 — 9	8 — 9	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	110 —112	111 —113	111½	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000	10	7 %	10 %	6 %	11 — 12	11½— 12½	11 13/16	11 11/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	13 — 14	13⅜	13½
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10 — 11	10 — 11	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
200,000	Do. 4½% Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	111 — 114	111 —114	113½	111½
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 6⅝	6½— 6⅝	6½	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16	15⅝	15½
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	15 — 16	15½— 16½	16	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅝— 4	3⅝— 4	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	9 %	12 %	12 %	14½— 15½	14½—15½	14 15/16	...

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Oct. 31st.	Closing Quotation Nov. 8th.	Business done during week ended Nov. 8th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅞— 3⅛	2⅞— 3⅛	3⅛	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	16¼— 17½	16½— 17½	16⅞	...
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13½— 14½	13¼— 14	14	13½
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	128½	126⅝
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	12	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6⅝	6½— 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅝— 2⅛	1⅝— 2⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2¼— 2⅜	2¼— 2⅜	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	109 —113	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	15 %	13 — 14 xd	13 — 14	...	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10⅜	10¼— 10⅜	10⅜	10¼
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5¼	4⅜— 5¼	5	4 15/16
71,447	Do. do. Def. do.	5	...	...	...	5 — 5⅛	5 — 5⅛	...	...
630,000£	City and South London Railway	Stock	1 1/16 %	1⅞%	2⅛%	63 — 66	63 — 66	64½	63½
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6¼— 6⅜	6¼— 6⅜	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3 11/16	3⅝
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½%	6 %	6 %	2 — 2½	2 — 2½	2 1/16	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½%	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	95	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2 — 2½	2 — 2½	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	104 —107	105½	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	¼ — ⅜	¼ — ⅜	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21½	21⅛
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	102	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½%	3¼%	3½%	8⅞— 9	9⅛— 9½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 13⅝	13½— 13¾	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	39½	38
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9½— 9⅝	9½— 9⅝	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	102	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
British Aluminium, Ordinary, 9—10; 7 % Pref., 9½—10½.
Brompton and Kensington, 4½% Debentures of £100, 105—108.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 1—3.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 18¾.

Bank rate of discount 5 per cent. (October 5th, 1899).

MARKET QUOTATIONS, Wednesday, November 8th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a " Nitric .. .. .. per cwt.	22/-	22/-	..
a " Oxalic .. .. .. per cwt.	32/-	32/-	..
a " Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) .. per ton	£29	£29	..
a " " .. .. per ton	£27	£27	..
a Bleaching powder .. .. per ton	£6 1	£6 10	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26	£26	..
a Lead, Nitrate .. .. .. per ton	£25	£25	..
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	5¼d.	5¼d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£25	£25	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a " Crystals .. .. .. per ton	£3	£3	..
a " Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£294	£294	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8¾d.	8¾d.	..
c " Tube (brazed) .. .. per lb.	10¼d.	10¼d.	..
c " Wire, basis .. .. per lb.	8¾d.	8¾d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£86	£88	£2 dec.
g " Wire (basis price) .. per lb.	10¼d.	10¼d.	..
g " Sheet .. .. .. per ton	£86	£88	£2 dec.
g " Rod .. .. .. per ton	£86	£88	£2 dec.
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	7/-	7/-	..
h India-rubber, Para fine .. .. per lb.	4/3 to 4/5½	4/2½ to 4/5	½d. inc.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	69/10½d.	69/6	4½d. inc.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 6 .. per ton	£14 5	£14 5	..
g Lead, English Ingots .. .. per ton	£17 12 6	£17 12 6	..
g " " Sheet .. .. per ton	£18 16	£18 16	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£9 5	£9 5	..
d Mica (in original cases), small per lb.	2d. to 8d.	2d. to 8d.	..
d " " " medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " " large per lb.	3/6 to 7/6	3/6 to 7/6	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd str'p & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. .. per oz.	£3 11	£3 11	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£143	£146	£3 dec.
g " foil .. .. .. per lb.	1/6	1/6	..
n " wire Nos. 1 to 16 .. .. per lb.	1/11	1/11	..
p White Anti-friction Metals—			
"White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7¾d.	7¾d.	..
j " Best Flax, 6 lea. .. per lb.	5d.	4¾d.	½d. inc.
j " Hemp, 8 ply 10 lbs. .. per lb.	3¾d.	3¾d.	..
j " " Russian, 10 lbs. per lb.	4¾d.	4¾d.	..
j " Jute, 180 lbs. rove .. per ton	£14	£13 10	10s. inc.
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£26	£26 5	5s. dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakespeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
Messrs. Henry C. Yoo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

STANDARDISING IN ENGINEERING CONSTRUCTION.

The general consensus of opinion in regard to cheap production is that standardising is at the base of economical manufacture. It is by standardising that repetition work is made possible to the fullest extent.

Sir Benjamin Browne, who deals with the question in the *Engineering Magazine*, does not think much of the Atbara Bridge argument, because for some reason which has never been made plain, the order was sent to America, without any English bridge builder having had a chance of trying. Where, he asks, is the line to be drawn between standard and special design? He does not believe in varying a lot of bridges for the sake of a trifling difference in span, his thought evidently being that in case of a number of bridges varying in span from, say, 20 feet to $20 + x$ feet, the whole of them might well be made of $20 + x$ feet span, rather than they should be made of several different spans. All being the same they could be made more cheaply, even though the total material might be greater in quantity.

The general feeling is that English engineers are too fond of their own designs, and the influence of Great George Street is indicated as having, in certain cases, seriously injured British trade, notably in bridges and locomotives. But it is not only Great George Street that is to blame. Our Midland and other railways are themselves guilty of demanding the most rigid adherence to hard and fast specifications for locomotives on the part of English builders, and have ordered from America engines to practically no specification. Need we say that Americans claim this as a sort of tribute to their unsurpassable ability to design and make engines, whereas, all it shows is the mistake of the railroad officials in getting behindhand with their engines, and having to order them in a hurry? The North-Western and the Lancashire and Yorkshire do not seem to have got themselves into the same fix. We recently commented on the lame and impotent explanation offered by Mr. Jones, of the Midland. Mr. Jones seemed to be much impressed with the fact that the imported engines would come over in wooden cases, and these wooden cases would not be all the same size. Seeing, too, how many foreign and colonial lines are engineered in Westminster, need wonder be excited if American engines are sometimes found to be preferred after a trial of English engines, designed by some inexperienced youth who has paid a heavy premium to his supposed teacher? The American locomotive is usually designed by an expert, just as are the locomotives built to the designs of English *builders*, but Westminster men cannot possibly be locomotive experts. Sir Benjamin is very severe on the Boards of Directors of our railways who so mismanage their lines. Here, again, we find fault with the English system. American railways—railways being their chief industry—command some of the best men. How very few English directors are really experts in railroading! Occasionally we see a retired manager go upon the Board when he is worn out, and clearly to go on the Board is a sort of halting place on the road to the grave. To be born a duke is also a sort of patent to a good railroad directorate, but our Board dukes have cost the country millions in bad policy. Civil engineers, says Sir Benjamin, will cause their assistants to get up designs for cranes, wagons, and all kinds of things that can be purchased like tin tacks almost, off ticketted shelves of the manufacturers, and of course infinitely better than the designs of a tyro. It is, he says, a great waste of time and energy to design on first principles articles of which other men have made specialties. Yet this is the Great George Street plan, which has not even the merit of Pecksniff's methods, for he did choose a perfect model.

The furthest development of standard work is certainly seen in America, where a manufacturer will sometimes make not merely one type of lathe, but only one size of that type.

Sir Benjamin deplores the abolition of the sub-contractor in the workshop. The contract system gave a man a chance of doing better for himself, for his hands were less tied than a foreman's, and he could bargain with men individually. Now, if trade is to be kept, the making of goods must be standardised as it has been in the textile trades. A huge spinning mill, for example, sets out to make 32s. yarns, and will make these or vary very little from this number, so little, that all the preliminary machinery will remain unaltered in its drafts and twists the year round. Textile machinery has long been standardised, and one hears of very little competition being successful against Lancashire. Much of the competition, we may say all, that is so much talked of at present, is chiefly due to want of business methods, and the worst cases that have arisen can be clearly traced to Great George Street influence. We have seen men of years of experience vainly endeavour to point out the errors in designs to young sprigs in Westminster, whose ideas savour of some half-century old bock from which, doubtless, their ideas were culled. But all this is everyday experience to specialists in manufacture who see thousands of pounds wasted and are unable to stop the folly.

THE MORRIN CLIMAX WATER-TUBE BOILER.

Probably the principal reason why large vertical shell boilers have been so unsuccessful has been that, there being no provision for regulating the circulation in the way of providing separate up-flow and down-flow passages for the water, it was impossible to avoid priming. There was so great a column of water through which steam had to make its way, that the water must have been full of struggling steam bubbles, and when at all thickened by contained mud or soda, the action of the steam must have been similar to that observed when a workman holds his coffee can over the smithy fire, and, by allowing too much heat to enter the can, empties it of all the coffee, leaving water only in the can. In the Morrin water-tube boiler the vertical type is adopted, yet without the faults of the shell

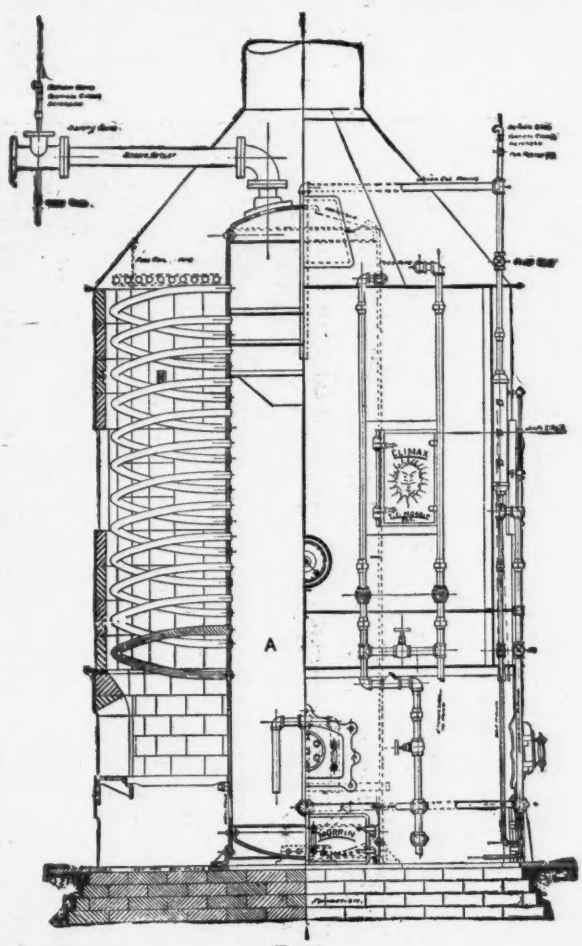


Fig. 1.

boiler—not but that a vertical shell boiler could be made to supply dry steam if proper provision were made for circulation. The Morrin boiler, as shown by figs. 1 and 2, consists of a central small diameter shell, large enough to work in for the purpose of using a

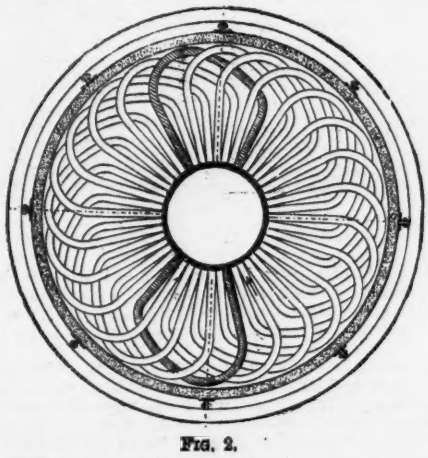


Fig. 2.

tube expander. Into this shell are expanded a large number of specially formed tubes, the particular beauty of which is, that though there may be 1,000 tubes in a large boiler, they are all alike, and consist of a straight length radiating horizontally from the shell towards the

outer casing, about half way to which the tube begins to curve laterally and upwards. Arrived near the casing the curvature, which had become flatter after the first bend, again becomes sharper, and the tube is turned in again radially to the central shell, which it enters at a height of about 18 inches above the lower end. It requires about six such loops of tubes to fill out the whole circle, but circumferentially on the shell between the two ends of a tube there will be three other tubes. Thus there are 24 tubes in a circumference, and a large number of such spirals in the height of the boiler. Their size is 1½ to 3 inches, and their number is 280 to 1,000, according to the size of the boiler, their aggregate length being similarly 1,000 to 12,000 feet.

The central shell is carried below the firegrate, and forms a convenient mud drum. The firegrate is annular, surrounding the inner shell, and the furnace space is formed by omitting a sufficiency of the lower tubes. Though much of the inner shell is removed by the holes for the tubes, this is made up by increased thickness. Indeed, the shell plate must be thick, on account of expanding the tubes into it.

The furnace is lined with a special firebrick, to assist combustion. The shell of this boiler is necessarily welded longitudinally, so as not to interfere with the tube spacing. In the upper part of the shell is a deflector plate, to throw down any water that may be carried up, and there are then several diaphragms placed in the shell whereby the steam which arrives beneath the diaphragms can only pass by them by traversing the tubes. In this way several passes of these upper tubes must be made by the steam, greatly to the advantage of dryness. Indeed, 80° of superheat are claimed. Above all is placed a coil of 100 to 300 feet of pipe as an economiser or feed water heater, and this should be useful as a heat abstracter from the gases before they finally escape. The general design of this boiler is good. Any tube can be removed without removing any other tube. A few spare tubes serve for a whole battery of boilers, all being alike. All tube ends are accessible internally, and a tube can be cut out and replaced in a couple of hours, or less. It is claimed that a 1,000-H.P. boiler only occupies a space 17 feet diameter. Having an annular grate, the boiler must be accessible all round for firing at usually four doors, though in places the back of the grate may be blanked off, and the front enlarged if required.

An advantage of this type of boiler is, that low water is not easily attained; that is, the water may fall a long way down without danger. There is no definite line for low water, and the heat is pretty well taken out of the gases by the time they reach the upper tubes. For coke, or for smokeless coal, this should prove an excellent boiler, and doubtless it can be adapted to use bituminous fuel, the furnace being already surrounded laterally with firebrick. It is claimed that this boiler may be used with good effect to burn waste gases from furnaces, and it is much used in America to follow plain cylinder boilers rejecting gases at too high a temperature. With good water, it should prove a durable boiler, and with scale-forming water its lower end forms an admirably devised collector.

We understand that the United States Commissioners of the Paris Exposition, 1900, have selected the Morrin patent "Climax" water-tube boiler for supplying steam to the whole of their section, and a United States cruiser has been placed at the disposal of the American manufacturers for transporting the boilers from Brooklyn to Havre. The large boilers installed will be under the superintendence of Messrs. B. R. Rowland & Co., Limited, 12, Exchange Street, Manchester, who have the sole rights of manufacture outside the United States, and no expense will be spared in making the installation an ideal one.

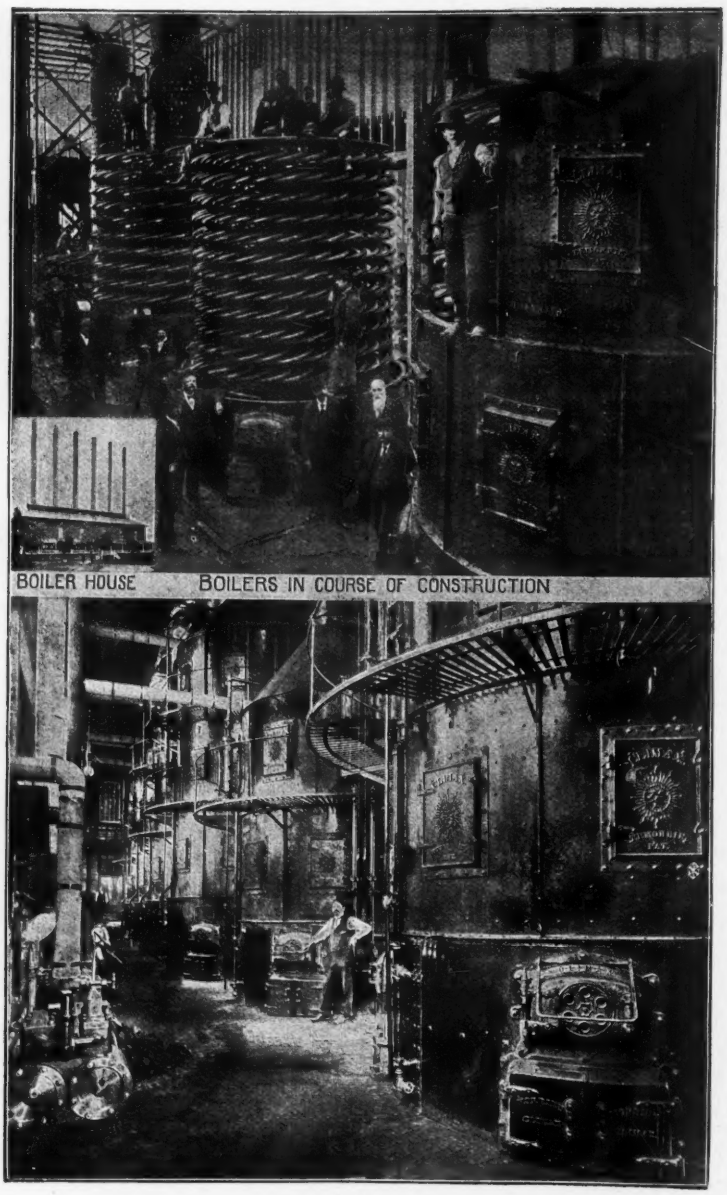


Fig. 3.

ELECTRIC RAILWAYS IN AMERICA.

The current issue of the *Street Railway Review* is a special one, and is a decidedly monumental number. One of the last articles is that descriptive of general practice in America, as shown at Chicago, which may be taken to represent the latest practice in the newer sections of that city.

Horse cars have practically ceased to exist in America. In this country, thanks to the class of men who are apt to pose as the people's representatives, we seem destined to use horses for some time to come. An English road surveyor, too, will take so exaggerated a view of his duty, that, rather than suffer his roads and footways to be defiled by a single pole, he will deprive, if he can, fifty or sixty thousand people of transport facilities. By many municipalities and surveyors, the Light Railway Act is reduced almost to a dead letter, and obstruction is being put in the way of progress never intended by the Legislature. In America over 90 per cent. of street railway mileage is electrical. In New York and Washington alone has the conduit system been adopted. Everywhere else the overhead construction is employed, its advantages being greater than its imaginary disfiguring properties. The third rail has come into considerable use on high speed lines. No important application has yet been made of any surface contact system.

The paper before us shows how very different American practice is from our own. Very little concrete substructure is employed. It is thought too rigid and unyielding, but more probably, as Prof. Short points out, the long-established roads of England, with their many years of compacted depth of metalling, are suited for supporting concrete, and such roads necessarily cannot yet be found in America, where track construction still involves the use of wooden ties, after the manner of English light railway construction. The ties are laid on a layer of broken stone or gravel in a trench at 24 to 36 inches centres, and the rails, 7 inches to 9 inches deep, are spiked to these, the paving blocks, in cities, being placed on sand, laid above the level of the ties, which are filled in between by broken stone or gravel. Tie rods are rarely used. As in England, rails are used up to 60 feet in length, the joints being variously broken or opposite, according to opinion; the latter tend, when down, to pitching, as against the peculiar rolling caused by alternating or broken joints when low.

Cast welded joints are increasing, they give excellent riding tracks. Electric welding is high in cost, but promises well. Bonds when used are supposed to have a slightly better conductance than the rails

they connect. Double bonding, so common in England, is stated to be frequently done, and cross-bonding is "usual," while plastic or amalgam bonds are coming into use. Double-truck cars are coming to be the mark of progress, and practice appears to be drifting in the way of such cars, 30 to 35 feet long, as, indeed, we fully believe they will become standard in this country. Trailers are but little used, as they cost more for labour per passenger. Trucks are of maximum traction type, carrying 60 to 70 per cent. on the drivers. American climatic conditions being so wide in range, there is great effort to secure a sort of combination summer and winter car easily convertible.

Of the American motor we cheerfully speak, for it seems to us that it is in their car motors that Americans have been easily first. There is really no sufficient reason for this. Motors are put to special stresses, but are not difficult to make. They can be copied, if need be, direct from American motors; but the one thing needful is good sound material for the insulation. Secure this, the rest is easy. There are among our own motor makers some who realise this, and their motors are all right. There are others whose insulation would disgrace a schoolboy's experiments, and such attempts to save on insulation must inevitably end in failure. Good though it is, it is an easy thing to make others as good as the American motor, and even better, but a silk purse never yet was made out of a sow's ear.

In power stations Americans have been forced by actual experience to come round to the English system of direct connection, and at the present time they are still trying to square the necessity of direct connection with the old-time speeds of rotation, from which they ought to have found themselves freed by the direct system. No doubt as the errors of the system of very slow speed are forced home they will adopt English methods throughout. It is curious that while making such huge progress in electrical traction American engineers should have had to adopt English practice in direct connection. Steam piping in duplicate is passing away, and better designed single systems are now in favour. In copying so much from American practice, English engineers copied, we believe, the use of duplicate steam pipes, but we think the duplicate and the ring main have disappeared in favour of well-designed single systems. The duplicate main, badly designed with its numberless valves, was always an invitation to disaster, and altogether useless, costly, and unnecessary.

In other respects such as fuel economisers or flue feed heaters, American steam practice has acquired much from us. The use of fan draught does not seem to have extended much into traction work in America, though it is progressing in other lines. We might profitably follow on the lines of mechanically-produced draught more than we have yet done. Though so old in England, progress has been slow in respect of fan-induced draughts. The largest engine generator yet built in America has a rated capacity of 4,500 KW.; many of this size are on order for the larger stations. Corliss valve gear is almost universal. The costs of generation have "been proved possible" to be as low as ·25d. to ·38d., but in by far the larger number of stations the cost is more like ·5d., a figure which should be easily possible in an English station of ordinary size.

There is a growing tendency—not yet materialised in plant, but only on paper—to use three-phase high pressure current with substation rotary converters, in order to keep down costs of copper. Such a system requires careful consideration: the cost of lost energy and of plant will soon overbalance the saving of copper; but, of course, it cannot be overlooked that in laying down copper, the cost of an insulated main is somewhere about double the cost of the copper itself, and each additional cable saved represents a good economy. Obviously, too, a buried copper conductor when dug up is only worth half its cost price if copper is at the same market value, the insulation being worthless except as fuel.

Feeder conduits are usually of vitrified brick or of iron pipe, the former as carried out to a considerable extent in Dublin in this country, the latter as in the most approved English practice. Aluminium has been tried for feeders, but it is too early to speak of results. Obviously the cost of insulation will be greater with aluminium. In overhead work there is little to choose between English and American practice. All details are practically American, and English makers follow American forms, but pole work is perhaps less elaborate; the American pole is ugly as compared with the tapering pole made by the English makers, but the elaborate brackets demanded by English municipalities are not asked for so much in America, where the wiser plan is followed of keeping the poles as unobtrusive as possible. Chicago, which fills so large a portion of the article under review, is supposed to be very congested at busy times of the day, but a picture of a light hour in the busy part of the city does not convey much of an impression of special congestion to one accustomed to London. Yet London has few trams, and these only horse worked, while a comparatively small city like Chicago, though unblessed with a County Council, has tramways aggregating 955 miles, and about 70 miles of elevated railroad in addition. The map published by our contemporary shows lines in almost every street at the centre of the city.

The cable system is rapidly disappearing from Chicago. The City Railway Company, which has electric, cable and horse roads, reports net car earnings per mile of 9·8 cents, 5·7, and −10·7 cents, on the three lines respectively. Various Chicago companies show operating expenses of 46·1 to 60·6 per cent.

As regards the Chicago power stations, one of the newest, that of the Southside Railway Company, was originally equipped with cross compound engines, with cylinders 26 inches and 54 inches × 48 inches, driving 800 KW. Westinghouse generators. Its two new engines are to be of 1,600 KW. capacity, with cylinders 34 inches and 70 inches × 54 inches, and capable of working up to 4,000 H.P. It is curious to note the low speed, only 80 per minute, which still clings to American practice, even for 160 lbs. pressure. Water-tube boilers are used with chain grates and conveyors. The chain grate is that so common at one time in this country, when under-fired cylindrical boilers were in vogue. The grate is an excellent one, and is familiar to our readers as Juke's. It has been much adopted in America, being as suitable for water-tube boilers as for under-fired cylindrical boilers. One station, only capable of running at first 90 cars, can now run 130 regularly, chiefly because of the gain in experience of the motormen. We fully believe this, and are of opinion that a meter in every car is very desirable as a check on mileage current consumption. In feeding boilers, the feed goes first through a heater, then to the pumps, and finally through the economiser. There is a huge water cooling tower 64 feet long × 34 feet high × 16½ feet wide, which will cool the water by 30° to 40°. Air is blown through it by five fans. The low cost quoted is attributed largely to an accumulator of two sets of 263 cells, each set of 750 KW. capacity. They can each deliver 2,400 amperes to the line, and have run up as high as 4,300.

The Chicago City power stations have rope-driven plants with small units. Of the 14 principal power stations, the capacity varies from 400 KW. up to 9,600 KW., with a total nearly 54,000 KW., of which, as regards boilers, 23,600 H.P. capacity is of Babcock & Wilcox type, 10,000 of Sterling type (Sterling boilers have small tubes nearly straight and not far removed from the vertical), 8,400 H.P. Campbell and Zell, and various others. Green economisers, not long ago hardly known out of England, are installed in large numbers. Water-cooling plant of 10,000 H.P. has been furnished to one station, and 7,500 H.P. of condensing plant has been fitted to another station. Direct acting steam pumps are much used, which we think a mistake for feed purposes. Such pumps have their use and place, but not as feed pumps for ostensibly economical plant.

As regards overhead construction, iron poles of 900 to 1,200 lbs. are used with wooden poles in the "alleys" between streets. The Union Traction Company use No. 0 hard drawn copper trolley wire, and No. 6 silicon bronze guard wire, which is used also for span wire in the business districts, while $\frac{5}{16}$ stranded and galvanised is used in the suburbs.

The Chicago City Company, however, use No. 00 trolley wire to help out the general feeder system, and a $\frac{3}{8}$ seven-strand galvanised iron span wire, but there are no guard wires on this company's system, as they are *believed to be a menace to life and property*, and where once installed have since been removed. All the details of overhead construction in the shape of hangers and pull-offs are of brass, except in one or two instances. Iron nowhere joins upon iron. Iron material wasted away rapidly, and the rust caused short circuits. Brass has better value as scrap when worn out. American contractors in England, please note.

India-rubber is useless as insulation; it soon cracks, and the cracks fill with coal dust and cause shorts. Treble insulation is made between trolley wire and ground—namely, at the ordinary straight line hanger, a fibre spool in the span wire about a yard from the pole, and another fibre spool at the pole band. A trolley wire span of 115 to 120 feet is allowed, at 75° F. temperature, to sag, 8 to 10 inches; in cold weather only 5 or 6 inches sag is allowed. The height above the ground is 19 to 19½ feet. Clinched ears are used, as they are less likely to let the wire down, and they will move on the wire if the trolley catches a span wire. The abolition of the sweated or soldered ear is of somewhat doubtful advantage. Certainly there is the risk on soldering that the copper wire may be softened and will pull apart. The tensile strength of soft copper is far below that necessary to withstand the pull required to keep the sag moderate.

Latticed poles are no longer employed; the best new construction is all done with tubular poles of the customary three sections—7 inches, 6 inches, and 5 inches—weighing 850 to 900 lbs., with extra strength for corners and anchor poles. In setting poles, their bases are painted with tar or other preservative mixture, and the bottom of the hole is lined with a slab of hard wood, to allow easy adjustment, the hole being filled round the pole with concrete. An iron thimble, 12 inches diameter, encircles the pole at the surface, and the space between pole and thimble is cemented up, and finished with a sloping roof to shed water. This precaution might well be adopted here in place of the finishing of the concrete at the surface level, where the pole is almost sure to be attacked by corrosion. For this purpose cement is superior to tar, which is apt to crack and let in water. Poles, where rusty, are steel brushed and painted first in red, then with a graphite paint, and usually require repainting every three years; trolley wires are found to oxidise most quickly when adjacent to the river. Poles are expected to last 20 or 30 years, which does not seem long, their annual depreciation being set down at 3½ to 4 per cent. Cedar poles depreciate 6½ to 7 per cent., and endure 14 to 15 years. Obviously these figures can only be assumptions, as no pole line has been many years in existence. The crossover insulation is composed of red fibre, 1 inch × 3 inches, attached to a central plate. The trolley wires are not cut, but are carried above the crossover, and no burn-out has yet occurred. Red fibre appears to do better in America than it has so far been found to do in this country. The section insulator is similar to the crossovers, but is hooded over to protect the fibre from rain. After exposure to weather fibre is apt to become harsh and brittle owing to the washing out of the substance which renders it pliable. This substance, we believe, is glycerine, which is easily dissolved out by moisture. At all section insulators and insulated crossovers there is hung from the span wire a small target with a star painted on it so as to call attention to the point and indicate to the motormen when to shut off current for the moment to prevent arcing. Garton lightning arresters are usual, but other types have all been tried. They are frequently inspected, and are tested by placing paper in the gaps and examining for punctures. Yet with all precautions the motor armatures are often damaged and underground lead-covered cables are burned, and this has occurred with an arrester on each side of the feeder points.

Return feeders are of two sizes, 350,000 c.m. and 211,600 c.m. Cables of 500,000 c.m. are found too heavy and are hard to maintain on the poles.

Underground cables are enclosed in vitrified conduit, the four duct sections of which are made 6 feet long. Within two or three miles of the power house the return circuit cables are allowed 25 to 30 per cent. more copper than the outgoers, to prevent electrolysis. Tower wagons are large and capacious van-like structures, with a tower rising from the roof. They are fitted with shelves for line material.

Owing to the high price of copper, the North-Western Elevated Railway has purchased 150,000 lbs. of aluminium feeders, of which half is already fixed. It has a section of 1,300,000 c.m., and is used uninsulated. It is supported every 9 feet, and anchored, and is much cheaper than copper per unit of current-carrying capacity.

The Calumet Company is coming back to wood as insulating material for hangers and strain poles. The bell shells are cast as usual, and filled by a wood block soaked in kerosene, and then boiled in paraffin wax.

Though as many as five cars are run as a train, but little has been done in regard to power brakes. Christensen brakes, with independent motor compressors, are used on the South Side Elevated lines, and a little on some other lines, but the Metropolitan line uses chiefly the New York air brake. Electric brakes have not become popular.

Electric heating is very general on Chicago cars.

The permanent way does not seem to be at all first-class. Joints are very apt to be low, the soil is wet and soft, and concrete is not employed. The rail is about 7 inches deep, and only 85 lbs. to the yard, with the usual flat table in place of the groove, and an overall top breadth of $5\frac{1}{16}$ inches. The elevated lines use an 80 lb. rail.

The Falk system is standard on the three principal surface systems, one company alone having now nearly 100,000 such joints. It is claimed that with careful sand blasting of the rail ends, the cast joint is electrically so good, as to obviate any need of copper bonding, which is nearly always omitted, but cross bonds are put in at about every 500 feet.

By April, 1900, a line closely resembling the Liverpool Overhead line will be in operation. This is the North-Western Elevated, seven miles long, with two miles of double and five miles of four tracks, the two inside tracks being for fast service. There will be three stations to the mile for local trains, but quick trains will stop only at every third station, and will average 30 miles velocity with 12-second stops. The station offices are below. The structure is chiefly of plate girder type. Pneumatic riveters are used in erection, and before painting the structure is steel brushed by electric power and flexible shafts, operated from the nearest trolley circuit. Two coats of paint at once follow upon the brushing. The paint is 20 per cent. oil, 40 per cent. graphite, and 40 per cent. iron oxide; 80-lb. rail is used, with 45-lb. conductor or third rail. The electric railway interest in Chicago is very great, and in a less, but at the same time hardly less proportionate degree, the electric line is bound up with the prosperity of almost every city and town in the Union. The absence of good roads and other peculiarly local circumstances have doubtless had much to do, in conjunction with the ease in obtaining "franchises," in fostering the electrical railroad. Our own backwardness, however, is not all due to the opposite causes. Much, of course, is due to the pernicious influence of the Tramways Act, and its unfortunate Section 43, or, perhaps, we ought to say, to the unfortunate quality of intellects which arbitrated on this section, with such disastrous findings. But the chief obstacle has, of late, undoubtedly been the jealousy of municipalities, and if every little municipality is to run and work its own tramlines within the narrow circle of its own boundaries, it seems impossible to hope that sound and paying general systems can ever be built up. It is a pity that in inspecting so many foreign lines at the expense of the ratepayers they profess to serve, the various deputations sent from our English towns should have seen so little and so narrowly—so little, we mean, of the tramways, and so narrowly in regard to the real issue—the facility of intercommunication between contiguous districts, which is so readily obtainable with electric traction.

GENERATION AND ELECTRICAL DISTRIBUTION OF MOTIVE POWER.

Discussion on Mr. Raworth's Paper read before the Manchester Association of Engineers.

Mr. Saxon opened the discussion by stating that it would be remembered that two papers had been read before the Association previously on electric power for cotton mills, one in 1892 and one in 1895, but at the present time they were no nearer than they were then. Now they had another paper with practically the same proposals. He was of opinion that Mr. Raworth's scheme was of such magnitude as to be impracticable. In order to get the 50,000 H.P. which Mr. Raworth spoke about, it would mean that there would have to be about 50 cotton mills taking an average of 1,000 H.P. each. Anybody who knew about the capital required for cotton mills, and where it came from, would agree that it was not likely that the capital could be found to build these mills. Then, of course, there was the capital required for the large generating station itself. The capital cost of this must be enormous, and to his mind the proposal was altogether impracticable.

Mr. Hans Renold gave some interesting data as regards the use of electric power in his works. He stated that the power was supplied by the Manchester Corporation, and he had paid 1½d. per unit for it, although he heard that it would be reduced after September to 1¼d. per unit. He had had many inquiries at his works as to the cost of driving as compared with steam. It seemed to him that that was the first question that everybody asked, but he thought the first question that ought to be asked was, what do you get for your money? For cleanliness and convenience there was no comparison between the two, and to his mind the great saving by the use of electricity lay in the fact that each department could easily see what power was being taken and could prevent waste immediately. He had some 100 H.P. motors installed, and since they were first in use in November, 1896, he had not had to carry out any repairs whatever, the only thing required being just the turning up of the commutators on three of the motors; these commutators had been worn through the machines being overloaded. Its convenience was very great. He had been puzzled for some time how to get power to his smithy which was across the yard away from the main building, but now with electric driving he had simply to run a pair of wires across the yard and switch the current on. The same remark applied to his pattern makers' shop, and in all these places by means of the ammeter they could tell exactly what power was being taken. He gave some interesting figures respecting the power taken to drive the shafting in his shops, and stated that with all the losses the cost to him to drive his machine tools was about ¼d. per hour, the cost for the largest lathes when working fully loaded being ½d. per hour. He thought that electric driving was more in accord with a modern workshop; one of the great advantages was that they could increase the power required from time to time with ease. When additional power was required all they had to do was to connect up by means of the wires and everything was then ready for them to start work. This was an important point, especially in a rapidly extending business where it was impossible to say what the ultimate power required would be, and he thought all these conveniences would warrant engineers going thoroughly into the matter of electric driving in the future before putting down steam driving plant.

Mr. Holmes said so far from no advance having been made during the last five years in the use of electric driving, he would say that his experience went to show that there had been a very large increase in the number of motors used during the last few years, and gave figures relating to the increased supply, year by year, of the Lundell motors.

Mr. Wordingham, as an electrical engineer, was naturally interested in the extension of the use of electrical energy in all possible directions, but at the same time he believed that sound progress could only be made on a solid basis of fact, and he regarded hypothetical figures which could not be substantiated in practice as likely to greatly damage the cause of true progress. He did not wish to take up much time, but as a direct attack had been made on the Manchester Corporation, he would ask the indulgence of the members for a few minutes. Mr. Raworth had evidently thrown down the gauntlet, and it was only left for him as the electrical adviser and the one responsible to take it up. This he did willingly, as Mr. Raworth's figures were so exaggerated that it would be an easy task. 1½d. per unit was stated to be a low price for a municipal service, implying that companies' charges were lower. What were the facts? There was no purely power station of which he had the returns, but he would cite the results in lighting stations, concluding that power stations would be *pro rata*. The average price taken over the whole country for municipal stations was 4·79d., for companies' stations 5·79d. The lowest price charged by municipal stations was 2·99d. at Edinburgh, and the highest 5·85d. For companies' stations the lowest price was 4d., or 30 per cent. over Edinburgh, while the highest price was 7·73d. at Hastings and Harrow, or nearly 2d. higher than the highest municipal station. He thought Mr. Raworth meant only to compare municipalities with the very large distribution companies which he had spoken of. These companies were very much in the air and were very much talked about. In Manchester they were actually constructing a station of 14,000 H.P., and were about to construct one having an ultimate capacity of 100,000 H.P. The site was purchased and the plans were in an advanced state. That was doing something. He proposed to examine, firstly, the items constituting the cost of supply; and, secondly, the possible saving to be made by large stations over small. He would here call their attention to the fact that the author made a verbal correction in reading his paper. On page 12 he so altered the wording as to make his estimates apply to generation only, no account being taken of any other expenses or even distribution. His estimate of ·384d. per I.H.P., he compared in the next paragraph with the Manchester price of ·93d., which, of course, included all expenditure. The items of costs of supply divided themselves into standing charges and running charges. The standing charges were those which were incurred for being able to work at a given rate, and were consequently fixed by the maximum power of the station. The running charges depended upon the number of hours the plant was worked. The standing charges were made up of interest charges on capital, cost of attendance of a certain number of men prepared to run the plant when wanted, and the cost of the coal necessary to be burnt to make up for radiation losses; this was an enormous item, and no one but a central station engineer could conceive the amount. The running charges were cost of additional coal for running engines, feed water, additional wages, oil, repairs, &c. All these were generation costs. The distribution costs were made up of interest on capital, cost of providing mains, cost of staff necessary to maintain them and to make the connections to consumers' premises. It was obvious, therefore, that the cost per H.P.-hour depended upon the number of hours the energy was used, because the standing charges

were inversely proportional to that. The amount of the standing charges and running charges, and their relative proportion to the total cost, was one that was not easy to accurately appraise, but this was done most carefully by the late Dr. John Hopkinson, than whom there was no greater authority, and whose name would assuredly carry weight amongst Manchester engineers. Dr. Hopkinson estimated that the cost of being ready to supply did not differ greatly from £9 per annum per H.P., and that the running charge was approximately ·295d. per H.P.-hour, so that on this basis the cost of Mr. Raworth's H.P.-year, reckoning 2,754 hours to the year, would be £15 8s. instead of £1 19s. 11d. The difference was substantial. Dr. Hopkinson's calculations were based upon actual prices for machinery, &c., and the engines were calculated to consume 2¼ lbs. of coal per H.P.-hour, assuming an evaporation of 9 lbs. of water per pound of coal, 20 lbs. of water per H.P.-hour, while the coal was assumed to be the best smokeless, costing 20s. per ton. Undoubtedly the steam consumption was high, and Mr. Wordingham assumed that it could be reduced to 12 lbs., and the price of coal to Mr. Raworth's 7s.; the figures then were approximately £8·80 per H.P.-year, or well over four times that calculated by Mr. Raworth. Dr. Hopkinson's figures worked out after careful study to about ⅔d. per H.P.-hour, against the ·93d. charged by Manchester. Mr. Wordingham went on to check Dr. Hopkinson's figures for capital expenditure by actual results, and also by recent estimates by Mr. Parshall. The capital cost per horse-power installed, taking the mean of 81 generating stations established in the country, as given by Mr. Garcke, was:—Land and building, £14·99; plant and machinery, £27·75; mains, £25·68; meters, £3·28; instruments, £0·951.; provisional orders, £1 86; or a total of £74 51. It was difficult to see how Mr. Raworth's ideal station could obtain its plant for less than one-sixth of that sum, for although the cost of land and buildings may be reduced, this would be counterbalanced by the heavy cost of the high pressure mains. Mr. Parshall, in a report to the Glasgow Corporation, estimated that in a station of nearly 20,000 H.P., employing engines of about 4,000 H.P. each, the cost of coal per H.P.-year would be £1 14s. The cost of oil, water, waste, supplies, labour and maintenance, all of which were apparently included in Mr. Raworth's labour, management, repairs, stores, was £1 3s. 6d., or a total of £2 4s. 10d., as against Mr. Raworth's 18s. 5d. Mr. Raworth stated that the Trafford Park Power Company were taking contracts at ·56d. per H.P.-hour. Mr. Wordingham hoped that if there were any shareholders besides those who were their customers, they would be satisfied with the result; he would not like to step into their shoes. He preferred figures derived from actual practice in many towns to estimates worked out on paper. It would interest members to know that the very low prices quoted were based upon estimates of cost founded on boilers fired with gas in connection with an ammonia recovery plant. As an advocate of a single large station under certain conditions as against a number of small ones, he might perhaps be allowed to point out on what grounds the saving was to be anticipated. Briefly, the items of saving were lower cost of management, cheaper land, because the station would be a high pressure one and could be placed at practically any point, large generating sets with correspondingly diminished cost per H.P. and diminished cost of attendance, and lastly, and above all things, improved load factor caused by the superposition of a number of different classes of demand, owing to the residential districts being tapped. In a place like Manchester, the city load fell off rapidly at about 6 o'clock. If consumers could be catered for when they went home, a new load was experienced, greatly prolonging the length of use of the plant. The case of Mr. Raworth's station was very different; he would serve 100 square miles of territory, but there would be a number of towns having similar load factors superposed upon one another, and the resultant load factor would be the same as any one of them, while the station would be handicapped with the enormous cost of the high tension cables. In conclusion, he would say that he did not feel that the Manchester municipal station had anything to fear from the hypothetical stations referred to in the paper, nor would Manchester consumers be able to purchase their energy at a lower rate than that at which it was supplied by themselves through their Corporation.

Mr. Lester Taylor had had very great opportunity of watching the rapid progress that electric driving was making, and the list given in the author's paper was very insignificant as compared with lists that might be furnished. There was no doubt that electric driving was very much more convenient than any other form of driving, and in nearly all instances the firms who had used it liked the power. He stated that in some installations special apparatus had been fixed to enable the consumer to record the current taken by any one machine. The apparatus consisted of a distributing box into which the ammeter circuit could be plugged, and by this means waste could easily be detected. Some consumers were not altogether satisfied with electric driving, but in each of those instances he had noticed that these firms had tried to sub-divide the power to too great an extent; there was a limit to this sub-division. He found that portable motors had been called very much into use. There was no doubt that electric driving was most convenient, and he thought it should receive the serious attention of the members of the Association.

Other members spoke respecting the power required by the shafting and machinery in cotton mills, but they were generally of opinion that even the costs given by Mr. Raworth were too high for them to consider at present. Then the electricity got into the cotton on the spindles, one gentleman remarked, and they did not want any of that.

Mr. Raworth replied that the discussion had been one of the liveliest that it had ever been his pleasure to have heard on his papers. With regard to Mr. Saxon's remarks, he had never stated anywhere that the energy would be to supply cotton mills alone, it was intended to supply workshops of all descriptions and power generally. He certainly never expected that capital would have to be found to build new mills round the supply station. He was pleased to hear that Mr. Hans Renold agreed with him in his scheme and thanked him for his interesting figures. Mr. Wordingham thought that he (Mr. Raworth) implied in his paper that municipal stations did not supply current at so low a price as did companies. He never intended to convey any such meaning, and as far as Manchester was concerned, he thought that through their very able adviser, Mr. Wordingham, backed up by his chairman, Alderman Higginbottom, they had done a very great deal towards popularising electricity for motive power. Mr. Wordingham stated that the annual capital charges, or rather standing charges, per horse-power were £9, and that in addition to this 0·295d. per H.P.-hour had to be added as a running charge. These figures were tabulated by Dr. Hopkinson some years ago, and although the prices of machinery generally were very much lower than they are at the present time, still the proportional cost was much lower now on account of the larger units employed. With regard to the Trafford Park Power Company, this was not being worked in connection with a gas ammonia recovery plant. It was worked by a steam plant with Universal engines, and the cost per horse-power for engines and dynamos was as low as £4. He was pleased to hear that Manchester was erecting a generating station and he wished it every success. He was glad Mr. Holmes's sale of motors during the last few years had increased so enormously. With regard to Mr. Lester Taylor he agreed that electric driving was very much more convenient, and also that it was necessary to exercise great care as regards the sub-division of the motors. In some cases it might, for instance, take 20 1-H.P. motors to drive 20 machines, but a motor of 10 H.P. would be required to drive the lot. He would like to inform the members that the electricity which got into the cotton was not of the same character as that which was put into the motor. The electricity which got into the cotton was called static electricity, and had nothing to do with that supplied to the motor. He thanked the members for the manner in which they had listened to his paper.

Mr. Hy. Webb, the chairman, proposed a vote of thanks to Mr. Raworth, which was heartily responded to in, as he called it, the good old Lancashire fashion.

A NEW INCANDESCENT LAMP FACTORY.

An article appeared last week in a contemporary, describing the factory which has been erected by the Berrenberg Electric Lamp Syndicate, Limited, for the manufacture of incandescent lamps on the system devised by Mr. Berrenberg. The main feature of this process is the use of so-called "mechanical" instead of mercury pumps. The great difficulty, up to the present, has consisted in the poor vacuum obtainable with the former apparatus. Mr. Berrenberg, by an ingenious device, has now removed this objection. Two sets of pumps are used, one for producing a fairly good vacuum, the other for obtaining the highest vacua for the exhaustion of the lamp bulbs. By enclosing the valves and joints of the second pump in a casing exhausted by the first, inward leakage is entirely stopped.

In this way a very high vacuum is obtained, free from mercury vapour, which is known to be detrimental to the useful life of the lamp. From both these causes the makers claim a long life and freedom from blackening for their lamps. Further, it is stated that, thanks to the good vacuum, the filaments can be more highly incandesced than in the case of lamps exhausted with mercury pumps, and that consequently the efficiency of the lamps is very high. Curves are given, showing that a 100-volt lamp of 16 C.P. nominal has an average candle-power of over 15 C.P. for 1,000 hours, with an efficiency of from 2·4 to 3·0 watts per candle-power during that period. If these figures can be realised in everyday work, there can be no doubt that they will constitute an immense improvement upon the lamps at present obtainable. We fear, however, that other claims put forward in the makers' own statements are somewhat too optimistic; apart from the absurd statement that "the consumption of current in 5, 8, 10, 16 and 25-C.P. lamps is only 2·5 watts," and that lamps of 600 C.P. take *one watt* (!), the makers aver that no energy is wasted in heat, and that their use will effect "a saving of from 5s. to 15s. per lamp in electric current, according to cost of current;" considering that the average annual receipts per 8-C.P. lamp only amount to 6s. or 7s., the last claim can only be founded on some such quibble as "we spoke of a 100-C.P. lamp," or "we did not say an *annual* saving." Such exaggerations recoil on the head of their perpetrator in the long run, and, at the same time, discredit the trade in general.

REFUSE DESTRUCTION.

We have before us a copy of a report or general observations made to the Municipal Council of Geneva, by Ami Wagnon, Président du Conseil Administratif, Delegué à la Voirie, on the question of the sanitation of towns by refuse incineration. The author of this report has brought together a great deal of useful material on the subject, and for much of his information he acknowledges his indebtedness to a number of English engineering and other technical journals. Like a modern orator of note, he appreciatively quotes the ancient laws of Moses as proving the necessity of employing the best methods of sanitation.

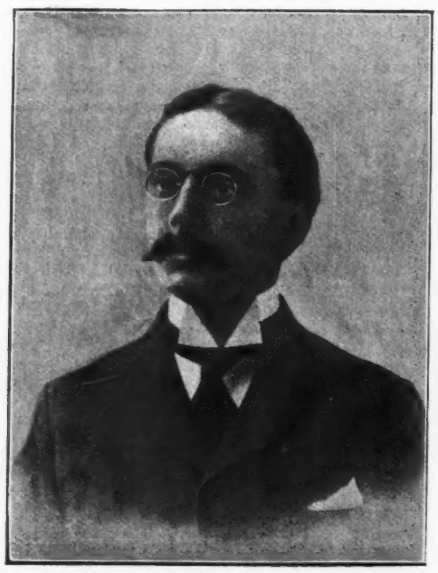
Refuse there is, and refuse there always has been, we can't get

away from that, the difficulty is to remove it in the speediest, cleanest, healthiest, and most economical manner. The enemy of health is split up into two parties, "the direct organic emanations, sewage of houses and factories," and garbage or "kitchen refuse and sweepings of all kinds."

At Geneva there is an urgent demand for an altered system of transporting and disposing of refuse deposits, therefore M. Wagnon has studied simultaneously the complete re-organisation of refuse carts, and the destruction of refuse by incineration, and has collected information showing what is being done in different countries, describing, in the course of his notes, an up-to-date destructor plant. The method of putrefaction, method of sorting, manufacture of manure and direct utilisation, are among the matters dealt with. These are followed by a reprint of extracts from a report by a Brussels Commission which came to England in 1897 to study refuse burning furnaces. The Horsfall system, established at Leeds, Oldham, Bradford, Edinburgh, &c., is described and well spoken of. Some notes and illustrations are given of the Horsfall furnaces (36 cells) at Hamburg, stated to be the largest installation of the kind in the world; also of the destructor at Powderhall, Edinburgh. The Horsfall system employed at Oldham, which has been worked since 1891 in connection with electricity works, is detailed, and notes are given of results obtained when working. The report gives expression to the opinion that the Horsfall destructor is the best that can be used for a town which is desirous of securing freedom from refuse and its ill effects.

TRANSMITTING PICTURES BY ELECTRICITY.

In the Electrical Review, Vol. xliv., p. 926, we described an invention of Mr. Ernest A. Hummel, by which pictures had been successfully transmitted over a telegraph line 1,500 miles in length. Another American inventor, Mr. William P. Dunlany, has been successfully working at this subject, as will be seen from the adjacent illustration,* where the transmitted portrait is placed side by side with the original photograph for comparison.



In transmitting a picture or drawing, it is first stereotyped on a flexible metal plate. The outlines of the picture are left exposed while the remainder of the surface of the plate is covered with non-conductive paint. This is the reverse of Hummel's method, where the picture was drawn in insulating ink on tinfoil. The flexible plate, in the Dunlany apparatus, is bent round a brass cylinder, which is rotated by an electromotor. An arm bearing a tracer is gradually moved from right to left by a fine threaded screw until the whole picture is covered by the tracer. Both sending and receiving instruments are governed by a simple synchronising arrangement which is not described. The tracer at the sending point controls the current on the wire, and closes the circuit whenever it comes in contact with the exposed lines of the picture.

At the receiving end, the apparatus is similar to that at the transmitting point. The projecting arm over the cylinder is, however, provided with a stylus controlled by an ordinary telegraph sounder. Around the cylinder are wrapped several sheets of paper with carbon copying sheets between them. The sounder bearing the stylus closes down on the cylinder and copying paper, recording the most minute lines in the original picture as the tracer at the sending point passes over them.

In transmitting written or printed matter, the process is the same, except that the copy is either written or copied on a flexible brass or metal plate, the circuit being broken whenever the tracer strikes the ink, which is non-conductive. In this case the receiving instrument is reversed, so that it records on the paper the opening instead of the closing of the circuit. The synchronising arrangement is so constructed that no matter how many receiving machines there may be cut into line, it is not necessary to have an operator to care for them. It is said that the operator at the transmitting point can easily correct or regulate the speed of all. Pictures have been transmitted by the Dunlany apparatus over a line 650 miles in length.

* *Western Electrician*, September 9th, 1899.

THE PENALTY CLAUSE.

(From a Legal Correspondent)

The article upon this subject, which was published in our issue of October 27th, may be usefully extended by a discussion of the following proposition:—Let us suppose that a Corporation enters into a contract with a firm of electrica engineers, who undertake to supply all the dynamos for the installation. By a clause in the contract, as drawn up, the Corporation is entitled to demand a penalty of £50 a day for overtime. Owing to pressure of business, the engineers are unable to complete their part of the agreement for several months after the day specified, with the result that the amount of the penalty exceeds the contract price. What, then, are the rights of the parties? Can payment of the entire penalty be enforced, although the inevitable result of such payment must be that the engineers not only furnish the dynamos free of cost, but pay a large sum in addition? We are assuming an almost impossible, but yet not unheard of, state of facts, for this reason, that every sound principle of law which is applied to the interpretation of contracts, should be capable of being pressed to its logical conclusion.

We have said that such a state of things is not unheard

of. There have been a large number of penalties enforced during the last three months. In one which has been brought before our notice, the contract price was £3,000, while the sum demanded as and for liquidated damages was no less than £4,000!

As we have already pointed out, the question whether the amount named in the contract is to be regarded as "liquidated damages" or a "penalty" depends upon the difficulty or ease which the Court is likely to experience in arriving at the true measure of the actual damage sustained. It may therefore be assumed that if a case similar to that under discussion was brought before the judge, his Lordship would be entitled to say, "The damage caused by one day's delay cannot be easily estimated, and the parties must be held to their bargain as far as possible. Although it would be preposterous to enforce the payment of such sums for an indefinite period, yet the contractor has made this bargain in full knowledge of all the facts, and unless he declares the contract off within a reasonable period, and thereby exposes himself to an action for breach of contract, his legal liability to pay the penalty must continue." As we shall see hereafter, there are a number of causes which may operate to prevent the Court from arriving at any such conclusion. That the Court does not go out of its way to assess damages may be gathered from the following case:—

A purchaser of the materials of certain old buildings was to remove them himself, and to repair those not to be removed, and cope the walls not to be taken down. He gave a bond that he would have the materials removed and the work completed by a day, or pay £10 "penalty" for each week he should be behind.—Held, that the breach was incapable of measurement, and the so-called penalty was really liquidated damages.—Bonsall *v.* Byrne (Ir. R. 1, C. L. 573).

An instance of the enforcement of a penalty which amounted to unliquidated damages in a very considerable sum, is afforded by the following case:—The plaintiff contracted to supply 5,414 tons of iron rails to a foreign company, delivery to commence by February 15th, 1873, and to be completed by April 15th, 1873, subject to payment of a penalty of 7s. 6d. per ton if makers should exceed the time named. The workmen in the employ of the defendants struck work, and defendants did not deliver any rails until the month of May. There was no strike clause. The whole quantity was not delivered until the month of September. *Held*, that the sum of 7s. 6d. per ton per week was a liquidated sum which the defendants were bound to pay to the plaintiff, but that it was only to be calculated from May 15th.

Another instance of the enforcement of a large penalty was afforded last year in the case of Thomas *v.* London Sewing Machine Company (15 T. L. R. 38). There a contract for service contained a clause to the following effect:—"If at any time during the said term the company shall by notice determine the agreement and the engagement hereby created without assigning any reason, the company shall thereupon pay to the said Thomas, by way of compensation and in full discharge of his rights and claims, the sum of £1,000." The jury having found that the plaintiff was not properly dismissed, Mr. Justice Matthew awarded the whole sum mentioned to the plaintiff by way of liquidated damages. He said:—"In any case I would have had great difficulty, in view of the terms of the agreement, in assessing the damages at any other sum than £1,000."

It should, perhaps, have been mentioned in our former article upon this subject, that the question whether payment of the full sum will be enforced sometimes depends upon whether the contract is, or is not, capable of being broken in one or more different ways. Thus, in the case of Law *v.* Redditch Local Board [(1892) 1 Q. B. 127], a contract made with the defendant corporation for the construction of certain drainage works, provided that the works were to be completed in all respects on or before April 30th, 1889, and that in default of completion the contractor should forfeit and pay to the urban authority the sum of £100, and £5 for every seven days during which the works should be incomplete after the said time.—Held, that as there was only one event, the non-completion of the works by the specified date, upon the happening of which the sums of £100 and £5 per week were to become payable, those sums must be considered as liquidated damages and not as penalties.

We have said that his Lordship *would be entitled* to decree the payment of a penalty for an indefinite period. It is obvious, however, that a preposterous figure would soon be reached, and the Court, although in an ordinary case it would be reluctant to attempt the assessment of the damage, would be driven to do so in an extreme case, and to declare, in effect, that the sum mentioned in the contract was indeed a *penalty*, and therefore capable of readjustment.

Although the strike clause prevents the time during which the strike lasts from "running" as against the contractor, it does not indemnify him from the disruption of business which generally follows in the wake of a trade dispute. Thus the great strike in the engineering trade brought about a congestion of orders which it was impossible for the undertakers to fulfil within the limited time after the men had returned to work. There has been no expression of judicial opinion as to how far the Court will allow the strike clause to cover the remoter damage. In the absence of authority it would seem that where no liquidated damages have been fixed, or where the Court has decided that the sum set apart shall be regarded as a *penalty*, and therefore capable of readjustment, all the evil consequences, both present and future, of a strike might be taken into consideration.

A further question sometimes arises, namely, suppose the corporation would have been unable, owing to the non-delivery of the boiler and engines, which were in the hands of one contractor, to make use of the dynamos if they *had* been delivered by another contractor within the time specified in his contract, would this excuse him from liability which, in the ordinary course of events, would have been consequent upon delay? No doubt such contingencies could and would be taken into consideration by a merciful corporation who were anxious to assist their contractors as far as possible. We are given to understand, however, that generosity is not an element upon which contractors should place much reliance in their dealings with the vestry or other local authority. For the determination of the legal point we are once more reduced to a consideration of first principles, without reference to judicial opinion. In the first place, it may be said that in all actions upon contract, if the plaintiff is unable to prove damage, his remedy will be *nil*. Of course, if the judge decides at the outset that the damages are "liquidated," the case is at an end. We may assume, however, that when considering the question whether the full penalty is to be demanded or no, the Court will inquire, Has there been any damage? If such a question is gone into, the defendant will clearly be entitled to call rebutting evidence to show that, by reason of other persons' delay, his own default caused no damage of a substantial character.

Yet another consideration forces itself upon our notice. If the corporation are able, by putting a little extra pressure upon their existing installation, to do the work for which the new plant has been ordered, is this an element which can be regarded in assessing the damages? Here, again, the absence of direct authority prevents us from giving a very satisfactory opinion; but it may be said that upon general principles of law, assuming the Court has decided the momentous question as to whether the sum named is "penalty" or "liquidated damages," evidence may be admitted to show that the damage occasioned by the delay was not so great as at first supposed. Thus, in the case of Oldershaw *v.* Holt (12 A. & E. 590), where the action was for breach of an agreement to build upon land, the defendant was allowed to show that the plaintiff had re-entered upon it under the covenant and let it to another tenant.

As we have stated, this opinion is put forward with some hesitation, as no direct authority can be cited in support of it. Yet one point is clear enough, namely, that there is no duty on the part of the contractor who supplies the dynamos to see that the boiler maker supplies the boilers in good time.

The contractor sometimes duly performs his contract, and has the machinery ready packed for delivery on the day named in his agreement with the corporation. Suppose they refuse to take delivery, has the contractor any remedy? This question appears to be answered by the 37th Section of the Sale of Goods Act, 1893, which says, "When the seller is ready and willing to deliver the goods, and requests the buyer to take delivery, and the buyer does not within a reasonable time after such request take delivery of the goods, he is liable to the seller for any loss occasioned by his

neglect or refusal to take delivery, and also for a reasonable charge for the care and custody of the goods. Provided that nothing in this section shall affect the rights of the seller where the neglect or refusal of the buyer to take delivery amounts to a repudiate of the contract."

With regard to the form of the contract which should be entered into with the District Council, or other local authority, it is important to notice that a penalty clause is sometimes compulsory, and if it is omitted, the whole contract is vitiated. Thus the Public Health Act, 1875, Section 174, Sub-section 2, provides, with respect to contracts made by an *urban* authority under the Act, that every contract, whereof the value or amount exceeds £50, "shall specify some pecuniary penalty to be paid in case the terms of the contract are not duly performed." In the case of the British Insulated Wire Company *v.* the Prescot Urban District Council [(1895) 2 Q.B. 463], the plaintiffs agreed to light the streets within the defendants' district for a period of five years for an annual sum. The contract contained no penalty clause, in consequence of which it was held not binding upon the defendants.

Upon the hearing of an appeal in this case, it was stated that the Local Government Board would sanction the payment of the arrears due under the contract which the Divisional Court had held to be invalid.

When we come to look at both sides of the question, it will be clear to all that the penalty must, in certain cases, be capable of being enforced to the last penny. A covenant providing for the payment of compensation for breach of contract is inserted not only for the purpose of defraying the increased expenditure which such a breach of contract may entail, but also for ensuring that the party under obligation to fulfil within the time named will use every means in his power to attain that end. It amounts, in fact, to a guarantee that the contractor is "ready and willing" to complete, that he will not embark upon other undertakings of an onerous character which might hamper him in the performance of his original agreement. Bearing these facts in mind, every contractor who stands aghast at the magnitude of the penalty which his employers are empowered to demand, should remember that if he accepts orders which are likely to occupy his men during the period which should be devoted to staving off the infliction of the penalty, he must set the profits earned by the execution of such orders, against the penalty which the non-fulfilment of the original contract of necessity brings in its wake.

If he sees clearly some time beforehand that he cannot possibly complete his contract, his wisest course is to serve a notice to that effect upon the corporation at the earliest possible date. That body will then be entitled to seek performance elsewhere. In a subsequent action for damages, the amount recoverable would be very materially reduced if the defendants were in a position to prove that the plaintiffs had ample opportunity of obtaining the execution of their order in another quarter. The ordinary clause providing for payment of a sum as a penalty, or as liquidated damages of so much per week or per day for the amount of delay, does not apply if the builder abandons the contract, or the employer enforces a forfeiture. For in such a case the date of completion cannot be ascertained, and the remedy of the employer in default thereof is provided for by the forfeiture clause or lies in an action for damages. [Ranger *v.* G. W. Railway Co. (1854), 5 H.L.C. 72, 113.]

Nor does it apply if the time for completion is extended. Thus, where an architect had power to extend the time for completion of the works, and to certify for payment, the works were greatly delayed. The architect certified without taking any account of the penalties:—Held, that he had extended the time, and no penalties were recoverable: Laidlaw *v.* Hastings Pier Company (1874), Ex. Ch., "Jenkins and Raymond's Architects' Legal Hand-book," 4th edition, p. 238.

ELECTRICAL DISTRIBUTION OF MOTIVE POWER.

The discussion on Mr. Raworth's paper on this subject, split up, as we had anticipated, into two lines of criticism; some speakers followed the proposals to supply power from a general power supply, others only touched upon the internal distribution of power by electromotors.

Mr. Wordingham's facts and figures were skilfully handled to prove that municipal stations could supply as cheaply as any company, but the figures quoted are not very convincing. The engineering of a purely power supply is a very different problem from that considered in a supply for lighting; it also differs from an electric tramway supply, and if the general power distribution service is to be confined to power supply only, and lighting is not to be supplied by the service, then the supply can no doubt be much cheaper, and the first cost of plant and distributing must be much less than in the combined supply system. The average demand for power would approach the maximum demand much nearer than is possible in any system supplying lighting as well as power. We, therefore, are inclined to agree with Mr. Wordingham, with regard to the colossal proposals to supply hundreds of square miles with electrical energy for all purposes, that the municipal supply would be quite as cheap. We believe there is room for purely power supplies, wholly apart from lighting, the standing charges connected with the latter supply being too heavy to be carried along with a power supply.

Mr. Wordingham was quite right in taking the proposed large schemes as combined power and light supplies, for in so doing he could discuss them from the point of view of practical experience in supplying power and lighting from one station. At the same time we regret that no one seemed to consider the possibilities of a supply designed for power only.

Mr. Sixon practically agreed with our own views in the matter of cotton and other mills; these large concerns get their power at a price per horse-power per annum much below any figure yet touched by electricity suppliers.

The contribution of Mr. Hans Renold is of interest, as he describes a case in which he finds it better to distribute power inside a factory by electro-motors than by mechanical means; in fact, he took up the secondary distribution part of the subject, and proved that in his case it is advantageous to adopt electrical distribution, even at 1½d. per unit delivered.

On this secondary distribution question the speakers, without advancing any solid foundations for their opinions, seemed to incline to the belief that sub-division of power was carried too far. Mr. Raworth even went to the extent of saying that it might take 20 1-horse motors to do the work of one 10-horse motor driving the lot; that is to say, assuming that all the machines are at work simultaneously, that the 1-horse motor's efficiency would be about 40 per cent. only. But in one of the tables in the paper we find a 1-horse motor (Lundell) with an efficiency of 74 per cent. and a 10 H.P. 84 per cent. efficiency, a difference of 10 per cent. only.

Therefore, to put the case properly, 10 1-H.P. motors would deliver without shafting 7·4 H.P., or 0·74 H.P. to each of 10 machines. It is very doubtful if the one 10-H.P., burdened with a shaft and 10 belts, would deliver as much power to each machine, because on the same basis it would only deliver 8·4 H.P. to the shaft which, with its 10 belts, would easily swallow up the remaining 1-H.P. due to the higher efficiency of motor.

Further than this the shaft would, with all its losses, run on all the time, even if driving only one machine; what would the efficiency of the 10-horse motor shafting and belting be then?

The fact of the matter is, that it is only by sub-division of the motors, and the consequent abolition of the constant losses in shafting and belting, that the secondary distribution can be shown to have economical results. This question of sub-division has not been carefully enough considered; it is a point requiring the utmost care in working out before advancing any statements for or against the limit to which sub-division ought to be carried.

An examination of a table appended to the paper proves that in most cases of shafting transmission, whether for large or small machines, the shafting uses more power than the machinery which it drives; while other tables, giving details of a few actual cases of secondary distribution successfully in use, prove that there is no

doubt now as to the superiority in every respect, of electric distribution inside the factories. In many cases primary distribution is in use successfully at 1½d. per unit, and we have no doubt that at 1d. per unit it would compete with 90 per cent. of the engines in daily use.

REVIEWS.

Manual of Electrical Undertakings. By Emile Garcke. 1899-1900. Fourth year. London: W. Alderson Smith, Donington House, Norfolk Street, Strand, W.C.

For the convenience of those who are closely watching electrical developments there is no more useful book than this *Manual*. To those who want to find out the financial condition of any electrical company (whether connected with the telephonic, telegraphic, lighting, traction, or manufacturing branches of the electrical industry), the book is indispensable, and it gives a valuable collection of serviceable data of other kinds. Section I. is devoted to telegraph concerns, and Section II. to telephone undertakings. Section III., devoted to electricity supply undertakings, is naturally the most extensive. It opens with general statements, recording the fate of the General Power Distributing Bill in Parliament, and the passing of the Electric Lighting Clauses Act, and details at some length the present situation in the City of London and the threatened competition. The total capital of 87 supply companies to date is given as £9,265,793 (this includes ordinary, preference, and debenture capital); the loans authorised to be raised by municipalities number 124 for 1898, with a total of £8,531,167; the capital expended by 65 companies and 93 municipalities in 1898 was £14,975,741.

The number of lamps connected (8 c.p.), and units sold, in 1898 is given as—

	Lamps.
70 companies	2,943,297
88 municipalities	2,716,586
158	5,659,883
	Units.
41 companies	42,672,384
64 municipalities	42,476,726
105	85,149,067

The price obtained for current is given thus:—

37 companies	5·51d. per unit.
61 municipalities	4·35d. „

For these 98 undertakings the average working expenses per Board of Trade unit sold (exclusive of depreciation and sinking fund) are:—

Generation	1·79d.
Distribution	·25d.
Rent, rates, and taxes	·22d.
Management	·49d.
Special	·06d.
	2·81d.

The detailed figures appearing under the different headings in the electricity supply section are brought together in a ready form for comparison, showing diagrammatically the average revenue per Board of Trade unit of energy sold, and the cost of production in different towns.

The "Traction" Section IV., also contains a mine of information which is essential to the rapidly increasing body of electric traction engineers. The railways and tramways constructed and constructing are particularised, and the present position thereof is noted, a list also being given of lines which are in course of promotion. A table is given which shows the total capital of the electric traction companies in this country up to date of publication as £19,639,530.

The amount of capital expenditure on electric traction by 11 municipalities is set down as £1,169,429, a figure which has been doubled, we should imagine, by municipal schemes lately set on foot in London, Manchester, and a host of other towns, although the money can hardly yet be termed expenditure. A second table shows the total capital expenditure and total length of tramways opened at June 30th, 1898. The capital, directors, officials, system, and so forth of the various traction concerns are given in detail. Section V. deals with electrical manufacturing undertakings, VI. with miscellaneous, VII. is a directory of officials, and VIII. gives a complete list of the electrical companies registered since 1856. The work is an ambitious one, but the compiler has succeeded in his attempt, and deserves great credit for the large amount of arduous work which its production has entailed.

A Standard Dictionary of the English Language. Prepared by more than 200 specialists and other scholars under the supervision of Isaac K. Funk, D.D., LL.D., editor-in-chief, &c. Complete in one volume. New York and London: Funk & Wagnalls Company. 1899.

Our opinion of this work is now precisely what it was in 1894, when we reviewed the earlier edition, in fact, it would be almost impossible to find words for praising it too highly. This opinion has been strengthened by some years' use in the Electrical Review editorial offices, where we have found it of very practical service. We suppose there never was a time when the need was so widely recognised for everyone who could afford it to possess a really first-class dictionary or encyclopædia. This has been very distinctly proved by the successful issues of such works by the publishers of certain London newspapers, who, we imagine, have derived a considerable profit from this enterprise. It is a sign that there must be something more than ordinary kudos to be obtained therefrom, when so firmly fixed an institution as the Printing House Square publisher launches out into the furniture dealing trade by selling a special line of bookcases, and by expressing practical approval of the hire-purchase system. But for those who want a cheaper dictionary—costing under a five-pound note—and complete in one volume, instead of half-a-dozen or more, Funk & Wagnall's is certainly to be recommended. For convenience of handling and reference, we prefer it complete in one piece, at any rate, for ordinary purposes, and in such matters as excellence of binding, artistic effects in printing and illustration, the dictionary before us leaves nothing to be desired. In regard to the text, frequent references have inclined us to the belief that "dictionary" is a modest term with which to describe it; an "encyclopædia" would be a more correct description, for it explains many things in considerable detail, more than one would find in an ordinary dictionary. The artist's pencil has been made good use of for placing representations of things before the reader's eye in a more interesting way, and the exquisite coloured plates of all kinds of birds, decorations of honour, remarkable ancient coins, flags of all nations, national coats of arms, familiar flowers, solar spectrum and typical colours, Röntgen ray apparatus and skiagraphs, &c., furnish instructive material for hours of never flagging interest. An important addition which we observe in the present edition is an atlas of the world. The electrical terms throughout the work have been very carefully selected and explained by Mr. R. W. Pope, as on the former occasion.

Magnetism and Electricity for Beginners. By H. E. Hadley, B.Sc., A.R.C.Sc. 1899: MacMillan & Co., Limited.

"This little book is primarily intended to meet the requirements of students preparing for the elementary stage of the Science and Art Department's examination," &c. Needless to say, therefore, it deals with magnets, single and divided touch, needles, nails, iron filings, sealing-wax, ice pails, universal dischargers, Leyden jars, &c., &c.—we all know them so well! Happily, however, a good section on current electricity follows; the various phenomena are dealt with in a clear and well-arranged style, and numerous experiments, many of them possessing features of novelty, are described, with hints for the rigging-up of simple apparatus for performing them. The latter, indeed, is a marked characteristic of the book. A special feature is a chapter on force, mass, weight, &c. We admit the necessity of this, for we

have known students who, after taking a three years' course in electrical engineering at a technical college, have been unable to distinguish between weight and mass, while acceleration was Greek to them. Yet they could solve differential equations!

The author rightly devotes much space to fields of force, potential, and energy. At the end of each chapter is a summary, followed by a number of test questions largely obtained from examination papers.

We object to the author's treatment of the couple on p. 37; a couple, applied as he indicates, would cause continuous rotation, not oscillation. The wording on p. 145, on negative potential, is obscure to a tyro; and experiment (ii.) on p. 240 would succeed as well without the presence of zinc, since iron filings are soluble in dilute sulphuric acid. On the whole, however, while we pity the author for having to write to such a syllabus, we welcome the book as one of undeniable merit.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

21,210. "Improvements in the method of and means for adjusting or setting of the points of tram lines and trolley wires of electric and other tramways." G. Barker. Dated October 24th.

21,219. "Improvements in electric cut-outs and in electric switch devices applicable thereto and serving as holders therefor." J. Sachs. Dated October 24th. (Complete.)

21,232. "An improvement in ear trumpets applicable also to telephone receivers and the like." L. A. Jacobson. Dated October 24th. (Complete.)

21,248. "An improved method of and means of mounting incandescence electric lamps." W. R. Lambert. Dated October 24th.

21,267. "Apparatus for enabling the positions of foreign bodies visible by the X rays to be located, and for guiding the operator in searching for and extracting the same." C. Remy. Dated October 24th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, April 4th, 1899, being date of application in France.)

21,276. "Improvements in magnetic separators." W. Clark. (C. F. Courtney, New South Wales.) Dated October 24th.

21,288. "An automatic electric switch." M. B. Ryan. Dated October 25th.

21,293. "Improvements in switch apparatus for use in the surface contact system of electric traction, and in operating switches used in such system." T. H. Parker. Dated October 25th.

21,302. "Improvements in or connected with electricity measuring instruments." C. Sondermann and R. Berlow. Dated October 25th. (Complete.)

21,311. "Improvements in an apparatus for exhibiting electric signals, advertisements and the like." A. J. Boult. (F. Y. Dalziel, France.) Dated October 25th. (Complete.)

21,313. "Electric motor." A. Fanti. Dated October 25th.

21,320. "Improvements in apparatus for separating magnetic from non-magnetic particles." J. Y. Johnson. Dated October 25th. (T. J. Greenway, S. Australia.)

21,329. "Means of maintaining and renewing the charge of electric accumulators, working motors for carriages, boats and other vehicles." P. E. Placet. Dated October 25th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, May 27th, 1899, being date of application in France.) (Complete.)

21,354. "Improvements in apparatus for electrically winding up or giving tension to driving springs." H. Aron and Aron Electricity Meter, Limited. Dated October 25th. (Complete.)

21,355. "Improvements in apparatus for measuring multiphase electric currents" H. Aron and Aron Electricity Meter, Limited. Dated October 25th. (Complete.)

21,375. "Improvements in or connected with trolleys or collectors for electrically operated carriages." R. H. Wilkinson. Dated October 26th.

21,378. "Combined maximum and integrating electric meter." E. S. Halsey Dated October 26th. (Date applied for under Patents, &c., Act, 1883, Section 103, March 27th, 1899, being date of application in United States.) (Complete.)

21,392. "Improvements in or relating to contact devices for electric railways and tramways." A. J. Boult. (H. Laval, France.) Dated October 26th.

21,400. "Tanning by aid of electricity." A. T. Wedelin. Dated October 26th.

21,413. "Improvements in safety fuses for electric circuits." J. Sachs. Dated October 26th. (Complete.)

21,429. "Improvements in or relating to incandescent electric lamps." C. Wolffhardt. Dated October 26th. (Complete.)

21,445. "Improved means for use in operating from a running car switches employed with a surface contact system of electric traction." T. H. Parker. Dated October 27th.

21,447. "Improvements in the method of forming armature coils for dynamos and electric motors and in apparatus for use therein." T. H. Parker. Dated October 27th.

21,470. "An automatic charging device for electric motor carriage." A. Muhlberg. Dated October 27th.

21,498. "An improvement in receiving apparatus for wireless telegraphy." J. A. Fleming. Dated October 27th.

21,509. "Improvements relating to the utilisation of the momentum of railway trains for the production of electricity." L. de Montgomery. Dated October 27th.

21,542. "A multilocular polytonic coherer." S. M. Bottone. Dated October 28th.

21,562. "A separator for plates of secondary batteries." H. Leitner. Dated October 28th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

2,849. "Improvements in electric switches." A. E. Tanner, F. A. C. Leigh and G. Hill. Dated February 4th, 1898. Relates to switches particularly adapted for use in lampholders. In the construction a block of porcelain is formed with a flat face, or is hollowed to receive the switch mechanism, which consists of a pivoted contact lever operated by a key, or preferably by a push rod. The rod is fitted with a pin working in a slot in the lever. A spring gives a quick break. One of the fixed contacts is connected to one of the leading-in wires, and the other to one of the terminals of the lampholder. The base may be fitted with extensions to separate the terminals. 2 claims.

3,032. "Steering torpedoes electrically." W. Jamieson, J. Trotter and A. A. Govan. Dated February 7th, 1898. Consists in the application of electric waves or oscillations of high frequency for steering torpedoes. The coherer is connected at one terminal to the conductor outside the torpedo for receiving the electric vibrations, while the other terminal is connected to earth. A battery is in series with the coherer and with the relay. The armature of the relay is in series with the battery, electro-magnet, two solenoids, and the selector switch. The selector switch consists of a tube in two parts, which are insulated from one another and capable of rotation on bearings. The tube carries a disc having four teeth in two planes, and the tube is rotated by a spring. Brushes connect the tube to the solenoids. The armature of the electro-magnet has a catch which is always behind one of the teeth on the disc. If the torpedo goes off its course, electric waves are sent to the torpedo, and reach the coherer which operates the relay, closing its secondary circuit. A current then flows through the selector to one of the solenoids, the iron core is sucked in to right or left, and the rudder is turned. When the waves are stopped the vibration due to the screw propeller restores the coherer to its original resistance, and the catch which first was drawn forward from behind one tooth, now swings back from the second tooth, and thus allows the selector to rotate half a revolution, ready, when electric waves are again sent, to turn the rudder in the opposite direction. If the rudder is required to be operated a second time in the same direction, two waves must be sent from the transmitter in quick succession. In a modification, the solenoids are replaced by an electro-motor, which rotates the rudder shaft. 2 claims.

3,198. "Improvements in the manufacture of carbons for electrical purposes." C. L. Saunders. Dated February 8th, 1898. Relates to a process for preparing carbons for electric arc lights and for other electrical purposes. Consists essentially in effecting the necessary intimate and uniform mixture of the materials employed in a wet state by the use of some of the ingredients in a liquid form. Any apparatus may be used. The crushed coke, lampblack, graphite, or other form of carbon is placed in a closed macerator having an agitator, and therein mixed with a suitable solvent for hydro-carbons, such as benzene, carbon bisulphide, eucalyptol, dead oil, &c., and with pitch, tar or oils, and any other desired ingredient, such as sulphuric acid, phosphates, cyanides, wax, or salts of sodium, strontium, &c. The slimy mixture obtained passes gradually into a vapour-tight wet-grinding machine, and from thence to a still having agitator arms. The solvent driven off passes to a condenser, thence to a separator for retaining water, and afterwards to a storage tank, from which it is carried back to the macerator. The dry powder left in the still is transferred therefrom, while still hot, to the cylinder of a forcing press, and forced into carbons of the required form. By adding the solvent only, the hydrocarbons present in coke may be dissolved out, the solvent recovered by ordinary distillation, and the heavy hydrocarbon obtained separately. The addition of pitch, &c., is then made, and the process proceeds as above. 6 claims.

3,204. "Improvements in electric arc lamps." C. A. Vigreux and L. V. Brillie. Dated February 8th, 1898. Relates to arc lamps. The carbon-holders, of which the upper one is heavier, are hung by cords from opposite sides of two pulleys secured near the ends of a shaft on which is also secured a toothed wheel in gear with a pinion on a brake wheel. This is loose on an axle which rocks on knife-edges and has an arm to which is pivoted a ring carrying a brake block on the left side, and the cores of series and shunt solenoids, the core being heavier. The arm may be weighted, or acted on by a spring. In a modification, the brake ring is connected to an arm of the rocking axle by a light spring, tending to disengage the brake. Either core and solenoid may be replaced by a weight. One core carries the piston of a dash-pot provided with a valve permitting rapid approach of the carbons, but preventing their rapid separation when the arc is struck. The valve may be a disc supported by light springs slightly above the piston, which is perforated and provided with a circular groove in its upper surface. In another modification for lamps of larger power, the carbon holders are suspended by pulleys in bights of the cords, the outer ends of these cords being attached to a special striking lever. This has a core situated over a series solenoid which produces a displacement of the striking lever, either lasting during the operation of the lamp, or only to bring the brake mechanism into operation, as desired. Jaws are hinged together and are closed on the carbon by a screw acting in opposition to a spring. The holders are attached to vertical rods and guided by sliding and fixed arms on insulated vertical rods, which form parts of the lamp frame. The pivot of the upper holder is hollow to receive its guide rod. 9 claims.

3,218. "Improvements in electric motors and dynamo-electric machines." H. H. Lake. (E. Cantono, Italy.) Dated February 8th, 1898. Relates more particularly to means for controlling the speed of motors by varying the excitation of their field-magnets, but the invention is also applicable to the regulation of the output of dynamos. The machine is composed of a pair of ring armatures situated one on either side of a central field-magnet, and mounted so as to be capable of a limited longitudinal movement on the shaft. Between the two armatures are interposed springs or buffers which tend to separate them, a tendency which is opposed by the attraction of the field-magnets. When by means of a rheostat or otherwise the field excitation is changed, the armatures approach or recede from the field-magnet, and corresponding variations of speed or output are produced. Each armature is built up of an internal ring on which a thin band of soft iron is wound, and this is enclosed in an external ring. The core thus formed is supported by wings radiating from a sleeve sliding on the shaft. To adjust the shaft longitudinally a ball bearing is provided at one end, the central double cone of which can be turned upon the screwed end of the shaft. This cone has several internal notches, any one of which may be caused to receive the key after a fraction of a revolution. The field cores are cast in one with their supporting crown, which has a small cross-sectional area. To facilitate the dismounting of the armature the upper pole and part of the crown may be detachable. The machine is enclosed in a casing composed of two parts secured to either side of the crown. Each of these two parts may have a removable cover. When the machine is used as a dynamo to charge accumulators, it acts automatically to regulate the output. 6 claims.

3,496. "Improvements in electrical cut-out apparatus." J. Andrews. Dated February 11th, 1898. Cut-outs in which the circuit is maintained by a normal or direct current, or broken by a return or excess current. A pivoted lever carries a spring end which fits between contact springs mounted on insulators. The lever is provided with projections against which the heel of a pivoted tumbler lever strikes when released by the spring detent. The lever carrying the detent is engaged by a stop on a shunt motor armature, and is only released when an inverse current tends to turn the motor backwards. The motor armature is normally held against a stop so as not to rotate by the direct currents. The catch lever and stop are so adjusted and shaped to give great sensitiveness. The shunt armature coil may be omitted, and a spring employed to hold the core in a suitable position to release the catch when an abnormal increase of current occurs. Springs or weights may be employed to hold the armature in the required position; a cam action may be employed instead of the stop. 3 claims.